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POST OFFICE

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JOURNAL

ONE SHILLING AND SIXPENCE

AUTUMN 1964

Marconi self-tuning H.F system—
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breakthrough

MST 30kW transmitter type H1200

An h.f linear amplifier transmitter for high-grade telecommunications.
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Output power: 30 kW p.e.p, 20 kW c.w.
Meets all CCIR Recommendations.

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Transmitters can be mounted side by side and back to back or against a wall. Floor-ducts are eliminated and all power supply components are built-in. These features lead to smaller, simpler, cheaper buildings or more services in existing buildings.

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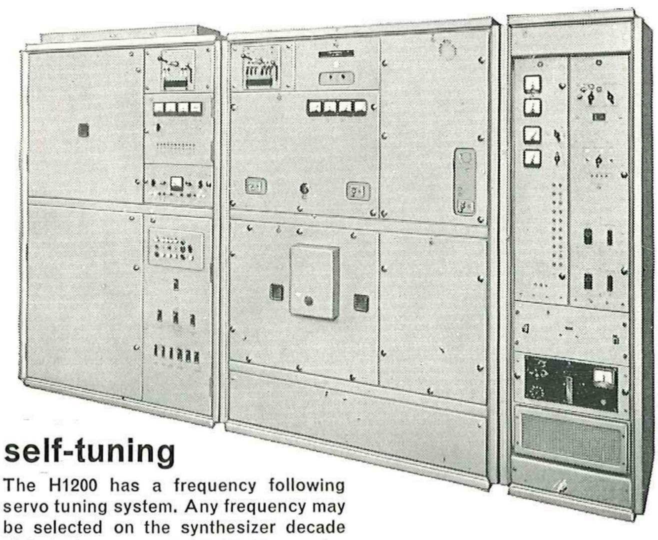
R.F circuits have been simplified and the number of mechanical parts reduced to a minimum. Highest engineering standards are applied to the design of these parts: stainless steel shafts in ball-bearings in heavy, rigid, machined castings; stainless steel spur gears meshing with silicon bronze; heavy r.f coil contacts with high contact pressure. Specified performance is maintained with ample margins.

simplicity

MST reliability allows continuous unattended operation with extended or remote control, saving maintenance and operating staff. Any fault in the servo control circuits can quickly be located with simple test routines. Transistors and printed wiring gives these circuits maximum reliability.



self-tuning

The H1200 has a frequency following servo tuning system. Any frequency may be selected on the synthesizer decade dials in the associated MST drive equipment; the unattended transmitter automatically tunes itself in an average time of twenty seconds. Final stage tuning and loading servos continuously ensure automatic compensation for changes in aerial feeder impedance caused by weather conditions. Self-tuning gives *one-man* control of an entire transmitting station.

Marconi telecommunications systems

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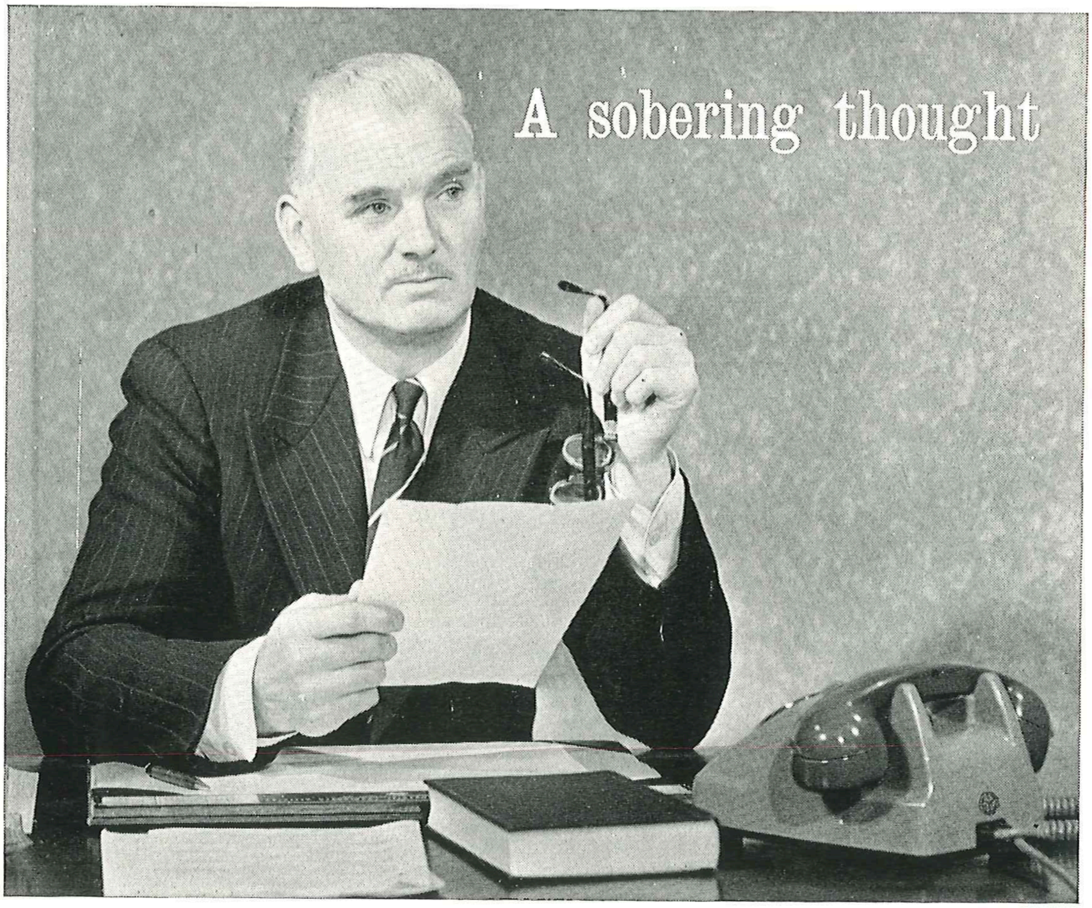

It is a fact that as we get older, the sense processes of the body become less efficient. Generally there is no startling drop-off, just a gradual diminishing of acuteness—so gradual that we are almost unaware of it. For example have you recently caught yourself saying "Speak up"—"What a shocking line" and so on. It may well be a bad line—the other person may be whispering but it could be that you are not hearing as well as you used to. If this is your experience an amplified telephone handset would be a real help.
Inconspicuous in use—these handsets look exactly like the ordinary models with the addition of a small volume control, but what a boon in relieving the strain of trying to hear on a bad line or to a weak signal or as an aid to those with diminished hearing.
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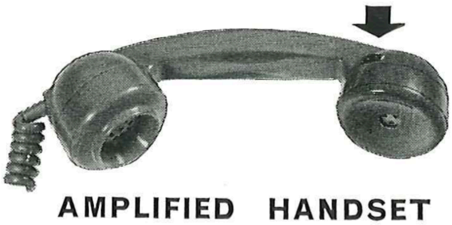

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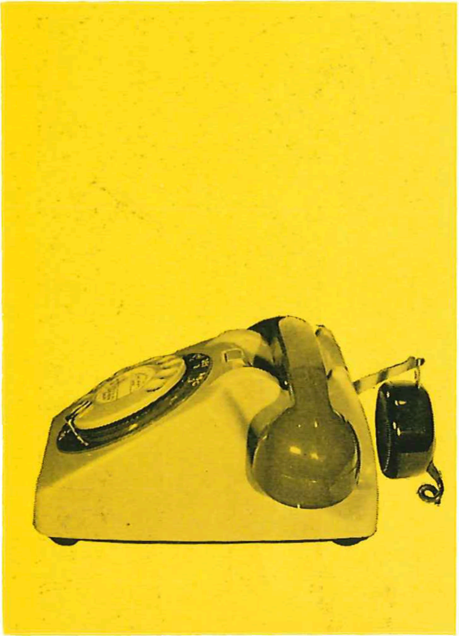

Post Office Telecommunications Journal

Published by the Post Office of the United Kingdom to promote and extend knowledge of the operation and management of telecommunications

BRITAIN'S STAKE IN WORLD SPACE PLAN

THE recent international agreements to set up a world-wide system of commercial satellite communications is welcome news indeed, particularly to Britain and the Commonwealth.

Britain is to have an 8.4 per cent share—the biggest after the United States which will have 61 per cent—in the £70 million global network which is expected to be fully operational by 1968. The British contribution, which will come from Post Office funds, will amount to about £6 million spread over the next five years towards the end of which permanent arrangements for a world-wide system to come into force by 1 January, 1970, will be considered.

The agreements also represent a major success for Britain and are a tribute to the far-sightedness of her satellite communications experts who, at a Commonwealth Conference in 1962, proposed the need for such an international system even before the first experimental communications satellite—*Telstar I*—was launched.

Commenting on the agreements at a Post Office Press conference, Sir Robert Harvey, Deputy Director General, said that by the summer of 1965 a high-altitude satellite to be launched over the Atlantic would provide about 240 two-way telephone channels and of these Britain might expect to have 40. After a short experimental period it was hoped that the satellite would be used for commercial purposes. It would probably be 1967 before something approaching a global system was established. A fundamental detail to be decided was whether to use high or medium-altitude satellites in the global system and studies on these were continuing.

Sir Robert emphasised that under the agreements the design, construction and establishment of the satellites and their tracking stations (called the "space segment") will be a co-operative enterprise but that the telecommunications ground stations will continue to be owned by the countries in which they are located. Control of the space segment will be exercised by an international committee which, at the outset, will have 12 members—eight of them representing European countries, including Britain. The British representative will be a Post Office man.

"A satellite system will be complementary to the existing and future submarine cable systems," added Sir Robert. "If the present rate of increase of 15 per cent a year in trans-Atlantic telephone traffic continues, the satellite system ought to be paying for itself within five years."

* *(See the article "A Bigger and Better Goonhilly" on page 7).*

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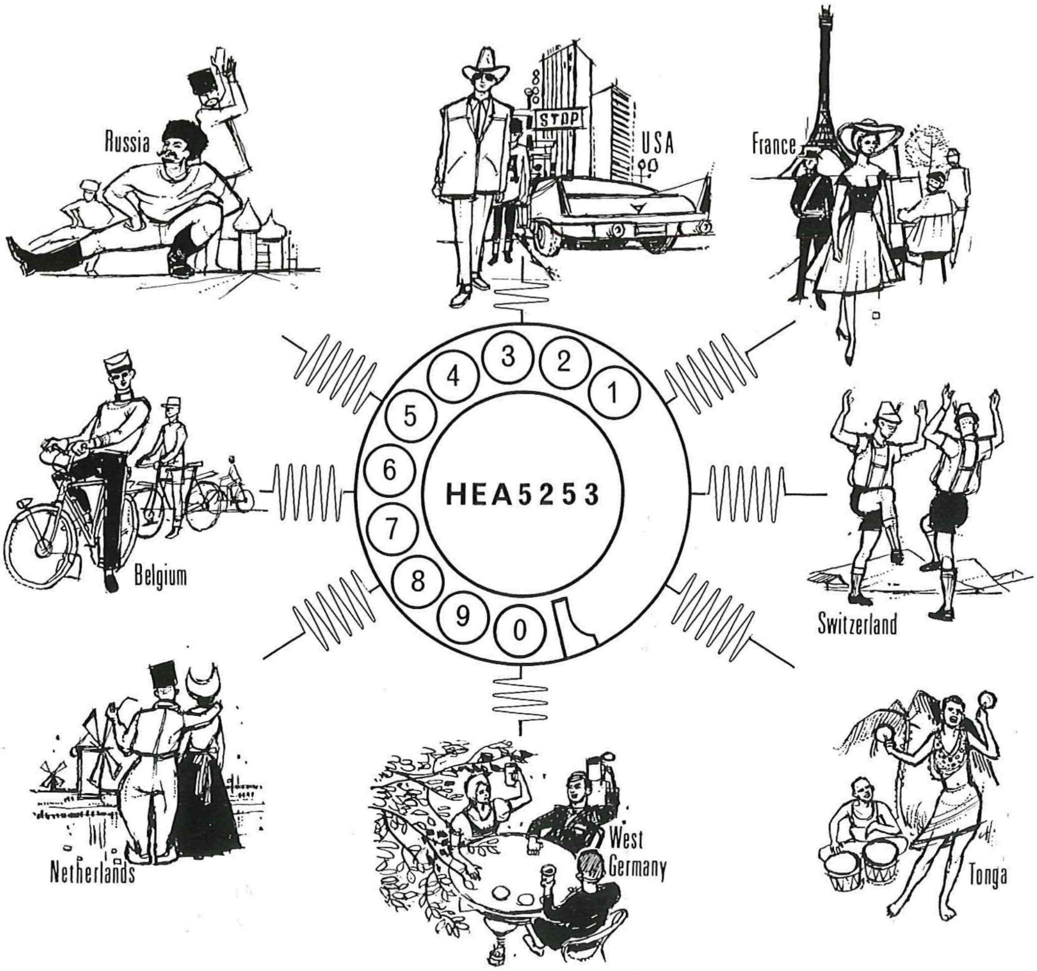


DIALLING THE WORLD

Fifty years ago making an inland trunk call was an adventure. Today, a start has already been made on a world-wide subscriber dialling system which is described in this article by W. G. G. ROLLASON and H. EGGLETON

AN important step has been taken towards the day when all telephone subscribers will be able to dial their own calls direct to any subscriber in any other country in the world.

At a meeting held in Rome recently, a special Study Group of the International Telecommunication Union agreed on the allotment of country codes to a large number of countries as part of a world-wide direct dialling plan designed to cater for the next 40 years and to accommodate a global telephone system with more than 600 million subscribers.

The new national code numbers fall into three categories: single digits for large countries; two digits for medium size countries; and three digits for small countries. For example, Great Britain has been allotted the code number 44, the United

States 1, Soviet Russia 7 and Tonga 676.

From Britain's point of view, the first stage in the plan to build a world-wide direct dialling system was reached in March, 1963, when London's STD subscribers were able to dial direct to subscribers in Paris. Strictly, this development was an extension of Subscriber Trunk Dialling (STD) since access to Paris was given over direct circuits from the Citadel exchange, the control centre for London's STD service. The code to be dialled, however, was selected to coincide with the actual digits to be dialled under the standard ISD system. This interim scheme was an attractive advance stage because traffic from London to Paris (over 2,500 calls a day) is more than four times greater than that from London to any other European city. It was made technically possible because the 1 VF signalling system introduced into Britain's inland service a few years ago was compatible, with only slight modification, with one of the signalling systems used in the French inland trunk service.

The London to Paris scheme provided much valuable information about the acceptability to London subscribers of dial service to foreign countries where the language is not English and the subscribers' reactions to dialling 13 digits to obtain a call. There had been serious misgivings that the language difficulty would deter the London subscriber from dialling his own calls to Paris but in the event this did not happen. Within a few days of the opening of the service, more than 80 out of every 100 calls to Paris from London STD subscribers were being dialled—in total more than ten per cent of all international calls from London.

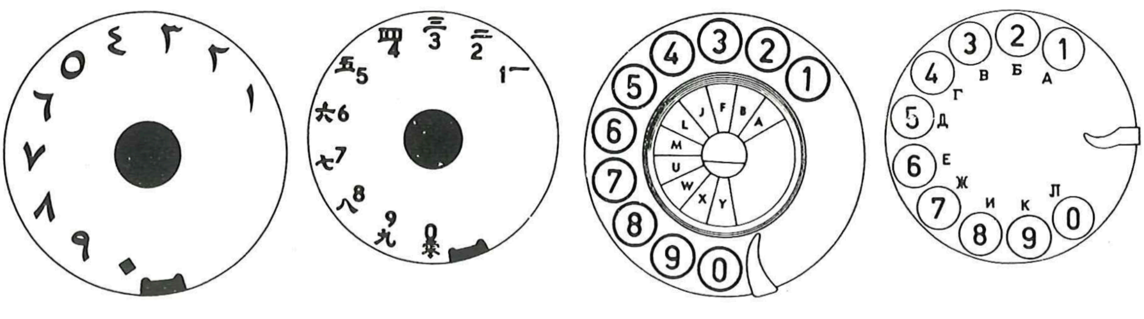
The first phase of the true ISD programme was completed in stages during April and May this year. First, the interim London to Paris dial service was transferred to new switching equipment at the International Automatic Exchange. Then the range of the new service was extended to allow London STD subscribers to dial to many other cities in France and to most subscribers in Belgium, the Netherlands, Switzerland and Western Germany. The new service uses one of the standard international signalling systems introduced some years ago for semi-automatic working between European countries so that the problem of incompatibility of national signalling systems does not arise.

With the completion of the first phase almost half the traffic from Britain to the rest of the world can now be dialled and, in fact, is likely to be dialled by subscribers themselves. In the near future ISD will be further extended, first to include STD subscribers in Birmingham, Edinburgh, Glasgow, Liverpool and Manchester by the end of 1964 and then, in 1965, to Sweden, Denmark, Austria and Italy and possibly to Finland and Norway.

Other telephone operating administrations are adopting similar ISD systems and this universal movement towards a fully automatic world-wide service has occupied the attention of the International Telegraph and Telephone Consultative Committee of the International Telecommunication Union for some years.

A special Study Group of the Committee has been set up to consider afresh the best possible arrangements for shaping the development of the world's telephone services so that automatic service

OVER



This selection of dials illustrates why all international numbers will have to be numerical. From left to right the dials belong to the following countries: Egypt; Singapore and Hong Kong; Australia; and Russia.

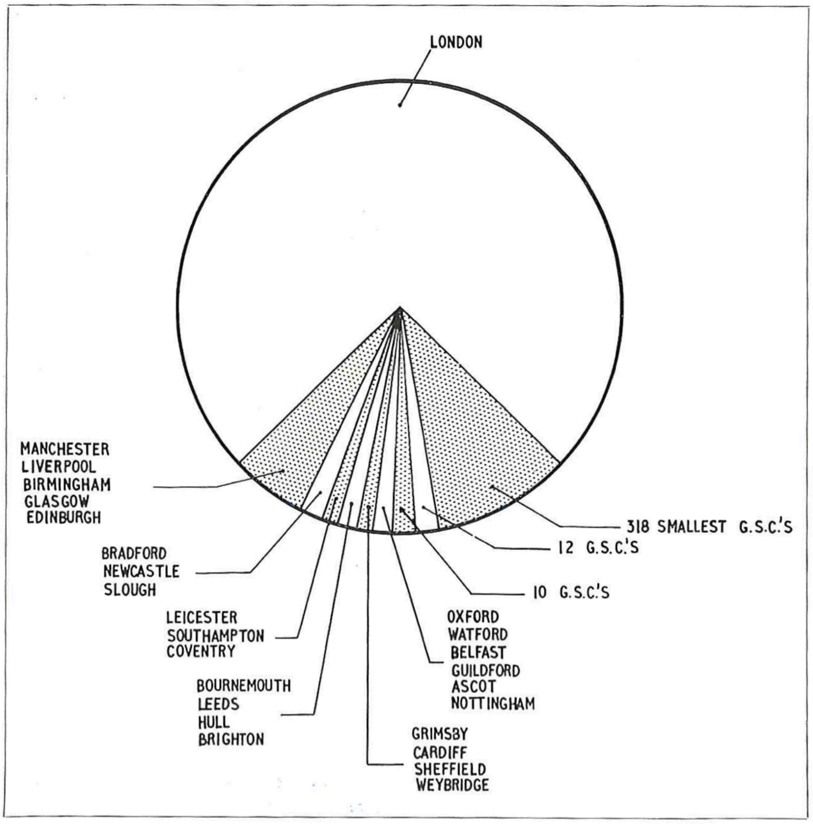
DIALLING THE WORLD (*Contd.*)

between all countries can be achieved. Among the most important matters now being considered are the form of subscriber's telephone numbers for ISD, routing arrangements and the best possible way to minimise confusion between the tones a caller normally hears in his own country and those he will hear from foreign exchanges.

Under the world numbering plan every subscriber in the world will have a unique number. In Britain, to provide for STD, subscribers' local numbers have already been expanded to national numbers incorporating prefixed national codes, of which the first digit is always 0. For example, the local number Aylesbury 6789 has the national number 0 AY 6 6789. To make a call to this number a subscriber outside Britain would dial an access code followed by the international number: 44 296 6789 (44 is the country code; 296, the numerical equivalent of AY 6, the trunk code; and 6789, the local number. Foreign subscribers will not have to dial the trunk prefix 0 of the British national number.

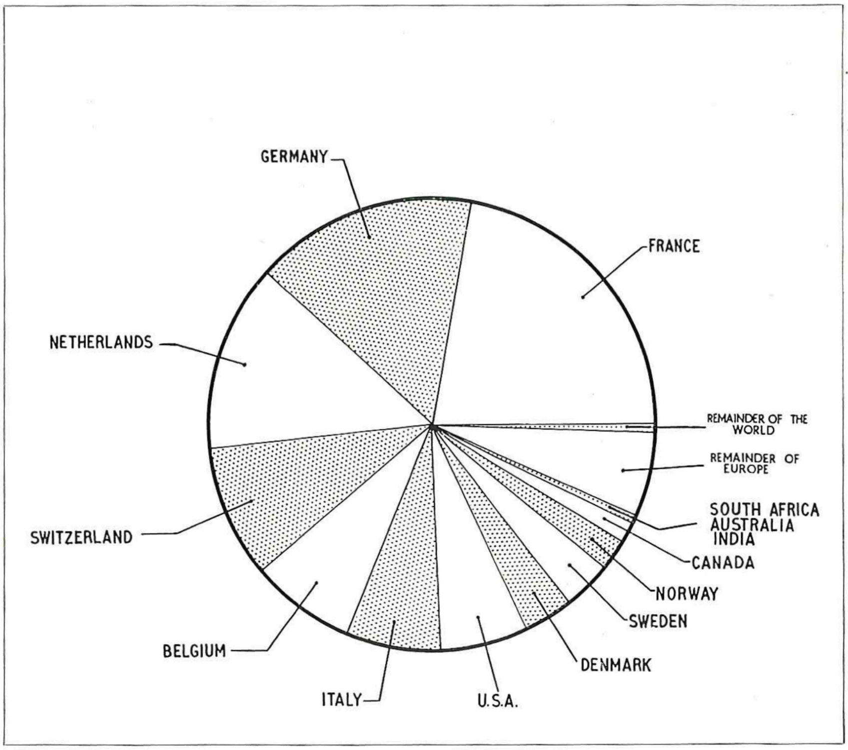
A subscriber in any country will follow an identical pattern when dialling an ISD call. First he will dial the access code which connects him to his country's international exchange, followed by the code of the country being dialled, then the trunk code of the required exchange and finally the called subscriber's local number. The subscriber in Britain, as he does now, will first dial 010 to obtain the International automatic exchange in London.

The country codes of the five countries involved in the first phase of ISD from Britain are as follows: Belgium, 32; France, 33; Netherlands, 31; Switzerland, 41; Western Germany, 49. Thus a subscriber in Britain calling, say, Paris 950–1001 dials 13 digits: 010–33–1–950–1001 (010 the access code; 33 the country code for France; 1 the trunk code within France for Paris and 950–1001 the local Paris number).



This diagram shows how the international traffic leaving Britain is distributed according to the originating group switching centres.

This diagram illustrates the distribution of outgoing traffic to other countries. Three-quarters of the traffic originates in London and the same amount is destined for a group of six countries.



Under the International Telecommunication Union's plan, all international numbers will have to be numerical because almost all countries use dials without letters and because the relative positions of letters and figures are not the same in all countries using the mixed letter-numerical system. For these and other reasons, several countries—notably, Australia, France and the United States—have recently decided to adopt the all-numerical form. It has been suggested that subscribers in those countries retaining mixed letter-numeral numbers should quote their international numbers in all-numerical form. For example, a subscriber whose number is London CENtral 9123 will be asked to quote his international number as 44-1-236-9123. This will be the number which will have to be dialled for an ISD call by a subscriber in any other country, preceded, of course, by the international access code used in that country.

The number of digits which make up national numbers varies from country to country. In the United States, for example, there are ten digits; in Belgium, seven; in France, eight, and in Germany eight, nine or ten. It is therefore clearly not possible to devise a world numbering plan in which all international numbers are of the same length. However, to minimise the variations the shortest country codes have been allotted to those countries which have the greatest potential telephone development, for instance, North America.

Will subscribers have difficulty in dialling such long numbers on international calls? A device which enables a caller to set up the number and check it before pressing a button to transmit it or a repertory dialler for frequently-called numbers would be most valuable aids. But even with the existing dial the evidence so far suggests that while some subscribers have difficulty the vast majority do not and welcome dial service as a great advance on manual service in which long numbers also have to be called. People make more mistakes in dialling long numbers, of course, but phrasing the numbers in presenting them in print greatly assists

OVER

DIALLING THE WORLD *(Concluded)*

the memory. For example, 010-331-950-1001 looks much less daunting than 0103319501001.

Automatic local and trunk telephone service in Britain has been readily accepted by the subscriber as has the first stage of ISD. There is no doubt that he will equally and eagerly accept automatic service to the rest of Europe and eventually to the rest of the world.

THE AUTHORS

Mr. H. EGGLETON is a Senior Telecommunications Superintendent in the External Telecommunications Executive. He entered the Post Office in Birmingham in 1936 as an Assistant Traffic Superintendent and moved to London Telecommunications Region in 1950. In 1954 he joined the Inland Telecommunications Department and in 1958 moved to ETE. He is at present concerned with the traffic aspects of international subscriber dialling. He was a joint author of *International Subscriber Dialling* published in the Spring 1962 issue.

●

Mr. W. G. G. ROLLASON is a Chief Telecommunications Superintendent in the Telephone Division of the External Telecommunications Executive. From 1930 to 1937 he served in the Engineering Department and in 1937 he became an Assistant Traffic Superintendent. In 1946 he was seconded to the Foreign Office German Section in Berlin and from 1950 to 1956 he was Assistant Controller of Telephone Services in the Sudan. From 1956 to 1961 Mr. Rollason was Controller of Telecommunications in Nigeria during which time he contributed *Developing Service in Nigeria and the Southern Cameroons* for the Spring 1959 issue.

THE FINANCES OF ISD

Charges for ISD calls from Britain are registered on subscribers' meters in the same way as those for STD calls. The pulse rates have been selected so that the charge for a three-minute ISD call is the same as that for a three-minute operator-connected call, but on ISD the subscriber pays only for the time he actually uses. He is not charged for a minimum of three minutes with subsequent one minute extensions as he is for a call connected by an operator.

★

An ISD call from London to Belgium, France or the Netherlands is charged in 2d units for each 4 2/7th seconds and one to Western Germany or Switzerland at 2d for every 3 seconds. Operator controlled calls are, respectively, 7s and 10s for three minutes.

★

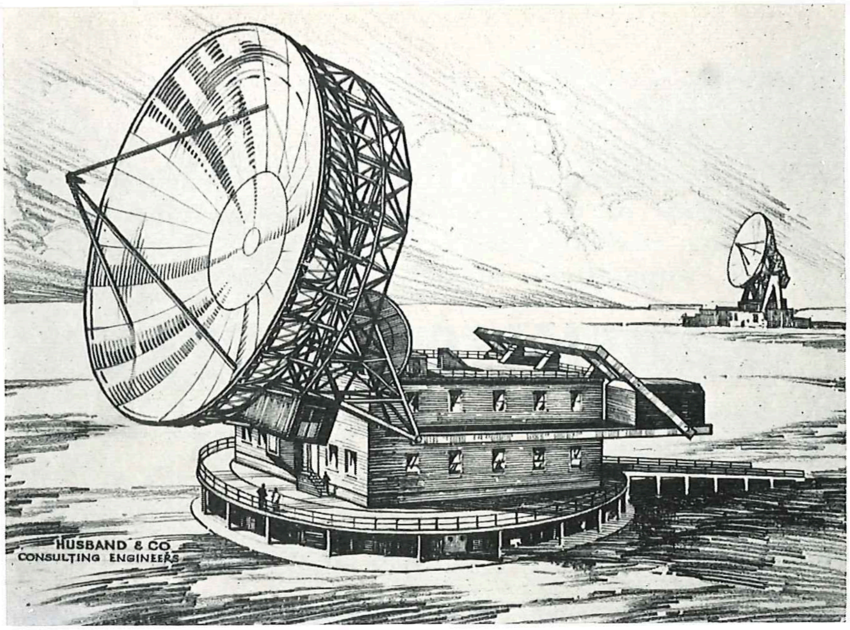
For a given amount of traffic the revenue under ISD operation is lower than under manual operation. Some European countries compensate for this by raising the charge for ISD calls so that the revenue is the same. The British Post Office practice, however, means that the savings resulting from the more efficient method of operation are passed on to the customer. In practice the greater ease of making calls is expected to stimulate traffic to the extent of making up the revenue to its pre-ISD level. The Post Office benefits from the more efficient exploitation of lines and savings in operator costs.

IN SEARCH OF NEW HORIZONS

BERNARD Hogben, former editor of the *Telecommunications Journal* and now the broadcast officer in the Public Relations Department at Post Office headquarters, has written three science books for children. Now comes a fourth—*Science and the Navigator* (Brockhampton Press, 12s. 6d.)—in which he tells the fascinating story of man's—and animals'—constant search for new horizons, from the time when primitive man went in search of food and water to modern times when man circles the earth in space and is on the threshold of setting off for the moon.

Mr. Hogben's book, delightfully illustrated by Kiff, is studded with the diamonds of little-known facts. Did you know, for example, that the Arctic tern flies 10,000 miles to winter in the Antarctic? That mallards, when released, always fly off in a north-westerly direction? That salmon can detect the river in which they were born by smell and taste? That the first magnetic compass is known to have been used in northern Europe nearly a thousand years ago?

The publishers say that Mr. Hogben's book is intended for young people of nine and over. Older people up to 90 and beyond will find it an equally interesting and valuable source of information.



An architect's drawing of the new aerial which is to be built at Goonhilly, with the present aerial in the background. The new aerial will cost about £1 million.

A BIGGER AND BETTER GOONHILLY

THE Post Office will be playing a full part in the first commercial intercontinental satellite communication system. The existing aerial at the Post Office experimental satellite communication ground station at Goonhilly Down, Cornwall, is to be modified (at a cost of about £250,000) in time to work to the satellite *Early Bird* which will be launched by the United States Communications Satellite Corporation in the spring of 1965. A second steerable aerial (costing about £1 million) will be erected at Goonhilly and electronic computers and radio telecommunications equipment provided by early 1966 and new trunk telecommunications links will be set up between Goonhilly and London so that signals can be fed into the international telephone system.

Announcing these plans at a recent press conference, Mr. J. H. H. Merriman, Assistant Engineer-in-Chief, said that the Goonhilly station was being converted to meet the exacting operational requirements which were not so important when transmissions were experimental. The experience of the past two years had amply justified the initial design concept of the existing aerial which was rugged, reliable, simple and comparatively cheap. It had a 99 per cent reliability record and was considerably cheaper than any other system.

The modification to the existing aerial will be completed by March, 1965, so that it will be in the "best possible position to co-operate fully with *Early Bird*." The primary task will be to improve the surface contour of the aerial. The centre section will be replaced by a single paraboloid, 25 ft. in diameter, surrounded by 24 separately-adjustable petals. The focal length of the aerial will be increased and the noise temperature reduced. The margin on the received signal level for satisfactory transmission will also be improved since *Early Bird* will be much farther away than either the *Telstar* or *Relay* satellites and because the station must be prepared to work almost continuously. The received signal power from *Early Bird* is expected to be less than about one-tenth of a million of a millionth of a watt.

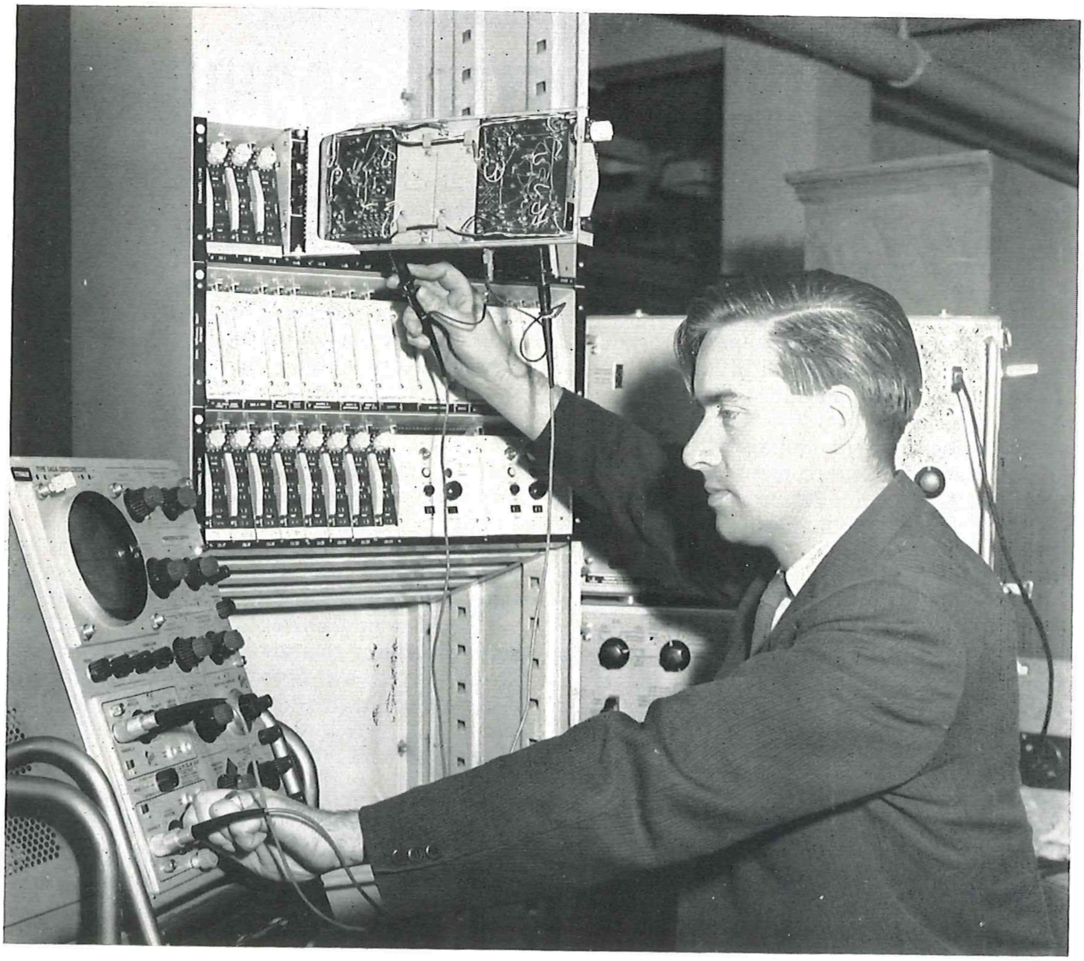
The second aerial, which will be similar to the modified aerial, will have much more room for radio transmitting and receiving equipment. It will be 85 ft. in diameter and tilt on one edge of a large two-storey rotating radio station. The complete structure will probably be heavier than the nine tons of the present aerial and equipment. In addition, an "on-line" computer control for tracking may be built into the system.

* *The United States satellite* Early Bird *will be launched to a height of about 22,300 miles where it will remain almost stationary—that is, it will move at the same speed as the earth's rotation. Its orbit will not, in fact, be perfect and it will describe a figure of eight pattern.*

In conjunction with three manufacturers the Post Office will soon be carrying out a number of trials with a new telephone transmission system which has exciting possibilities. It may, for example, enable junction cable capacities to be considerably increased

A NEW TRANSMISSION SYSTEM GOES ON TRIAL

By L. J. BOLTON
and G. H. BENNETT



FIELD trials are soon to be held with a new transmission system called pulse code modulation (PCM) which, if successful, may considerably increase the capacity of junction cables and do so more cheaply than laying new cables. There will be three trials, each providing 23 or 24 circuits and using a separate pair of wires for the transmit and receive directions and all operating over the Post Office network.

The first experimental PCM system, supplied by Standard Telephones and Cables Ltd., will be tried out between Guildford and Haslemere; the second, by the Automatic Telephone and Electric Company, between Reading and Marlow; and the third, by the General Electric Company, between Coventry and Rugby. All the systems will be less than 20 miles long. The PCM terminal equipment will be housed in exchanges with intermediate repeaters inserted along the routes in cast-iron cases in manholes.

Pulse code modulation is one of the most promising new developments in telephone transmission systems, particularly since it enables good quality circuits to be obtained even in conditions of high interference. Multi-circuit systems can readily be achieved by using time-division multiplex (TDM) techniques in which, briefly, all the

◀ **Left: Checking the waveform of the 8 kilocycles pulse amplitude modulated signal on the General Electric Co's PCM equipment.** *Picture: Courtesy GEC.*

bandwidth is available to all subscribers for successive short intervals so that a large number of circuits can be carried on a single transmission path. Now, with the introduction of new circuit elements into pulse code modulation techniques, the possibility arises of increasing the number of junction circuits per pair of wires on audio cables.

Because junction cables were designed for audio working, crosstalk performance (mutual interference between two or more circuits) is poor at high frequencies. Conventional carrier systems employing frequency-division multiplex techniques (FDM) in which a portion of the frequency spectrum is available to each subscriber all the time, have only a limited application on junction cables because crosstalk creates unacceptable interference unless the number of systems on each cable is severely restricted or costly steps are taken to reduce the effects of interference. In pulse code

This engineer is shown examining a PCM two-way repeater mounted in a Post Office No. 1 type repeater box. When it is fully equipped the repeater box mounts 12 two-way repeaters and the associated supervisory equipment. *Picture: Courtesy GEC.*

modulation systems employing TDM techniques, however, the line signal is not only different in form from that in FDM systems but it is also much less prone to disturbance from interference. Thus, PCM working on audio cables, which has already shown considerable promise in laboratory trials, merits serious consideration.

In conventional FDM carrier systems the signals in the various channels each occupy a separate frequency band. Interference on the line may impair the received signals in a number of channels and, although devices known as compandors may be used to reduce the effects, this is a costly expedient. In a PCM system, however, information

OVER

Two Automatic Telephone and Electric Company's engineers installing one of the PCM repeaters for the trial between Reading and Marlow. When fully equipped, 12 24-channel, bi-directional repeaters are accommodated. *Picture: Courtesy ATE.*

A NEW TRANSMISSION SYSTEM (*Contd.*)

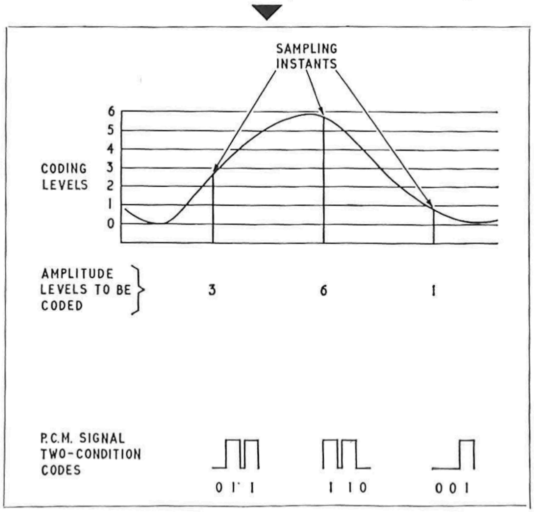
corresponding to the voice frequencies in each channel is transmitted as a group of impulses, each group being a coded indication of the size of the signal in the channel being sampled. Each channel of a multi-circuit system is sampled in sequence and at the distant end the information must be correctly allocated to the appropriate channels. Because of the characteristics of the cable the pulses are considerably distorted during transmission but replicas can be regenerated at intermediate points and at the receive terminal. So long, therefore, as the line noise does not prevent the existing impulses being recognised, and provided that the correct relationship of the pulses is not disturbed, the original pulse pattern can be reproduced at the distant end.

The bandwidth needed to transmit a PCM line signal is much greater than that for an equivalent FDM system—a 24-circuit PCM system requiring about 1,500 kilocycles a second compared with 100 kilocycles a second for a conventional 24-circuit system. This means that the line signal must be frequently regenerated, a requirement which would have made PCM working uneconomic had valve repeaters been used, because of the accommodation and power requirements. Today, transistorised repeaters which are small and inexpensive and enjoy reduced and simplified power requirements, are available. These repeaters are very suitable for housing in metal cases in manholes, power being supplied over the cable pairs to which they are connected.

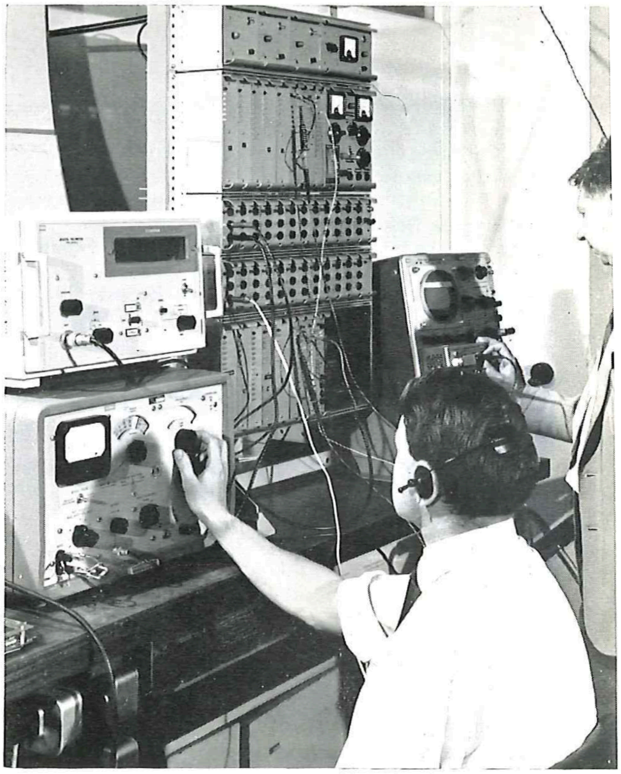
In converting each voice signal, the first step is to determine the size of the waveform at suitable time intervals. The waveforms are then coded, each code being a different arrangement of a short group of pulses. A decoder in the receiving equipment recognises each group and hence the original speech is recovered.

A number of coding methods have been devised, each possessing the common feature that the codes, or pulse groups representing the instantaneous amount of the speech waveform samples, are established by means of "two-condition" circuits.

These diagrams illustrate (top) a section of the speech waveform and (bottom) the line signal into which this would be converted by a 3-digit PCM system.



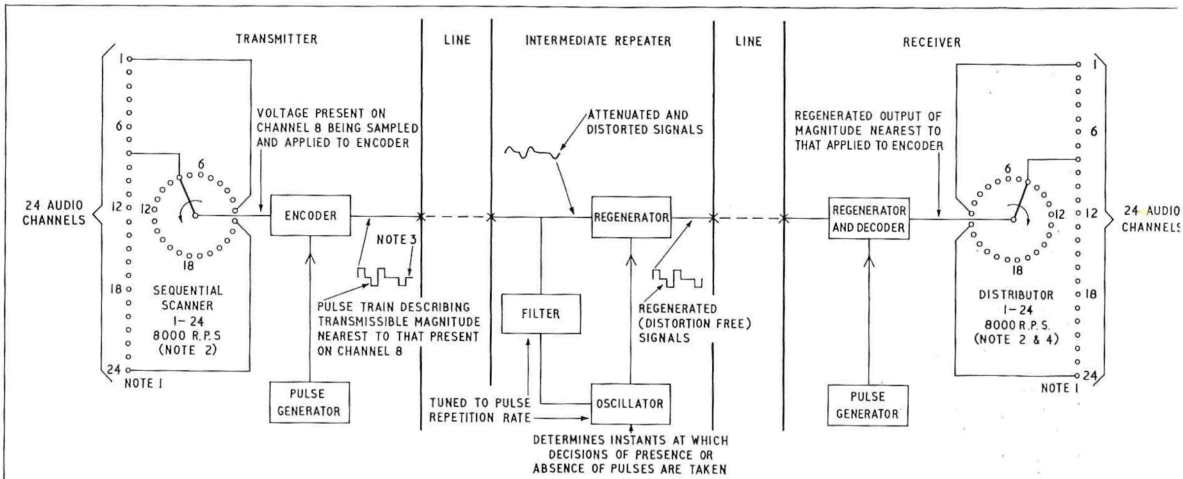
A 23-channel PCM transmission terminal, built by Standard Telephones and Cables Ltd and due to be installed on the 13-mile route between Guildford and Haslemere, receives its final check for the quality of the speech channel. *Picture: Courtesy STC.*



In only one of the two conditions is a pulse transmitted. With seven "two-condition" circuits 128 different sample magnitudes can be represented. However, even with this large number it is frequently not possible to represent precisely the magnitude at the moment of sampling and in such instances the nearest of the 128 values is chosen. The information transmitted to the receiving terminal will, therefore, contain small errors—manifested as noise superimposed on the received signal—which correspond to the difference between the true magnitude signal and the actual coded value. The amount of noise can be reduced by increasing the number of "two-condition" circuits but in practice seven are adequate for commercial speech.

In addition, it is necessary to transmit synchronising information to ensure that the receive terminal keeps in step with the transmit terminal so that the correct information is allotted to each channel. It is also necessary to transmit signalling information and on the forthcoming PCM trial systems the pulses representing this will originate from relatively simple transistorised relay sets which give adequate facilities for junction circuit use.

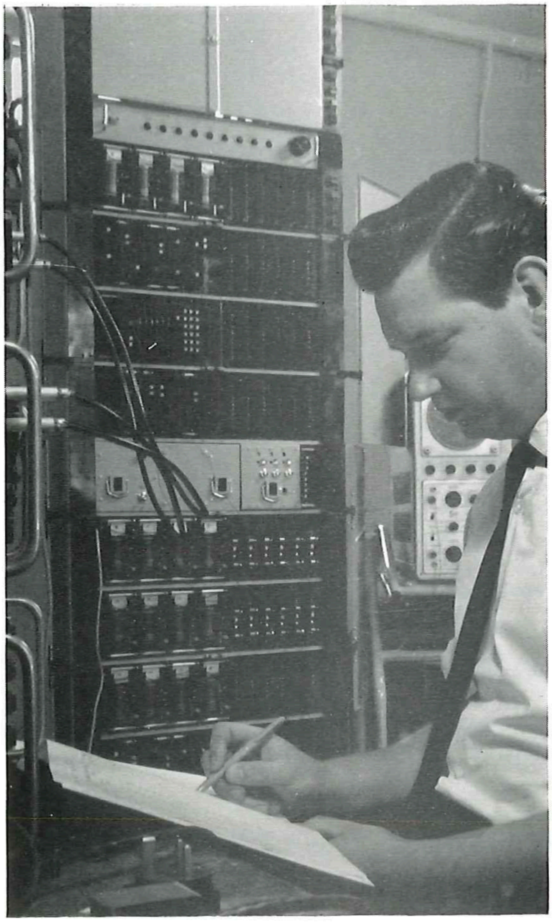
OVER



This diagram illustrates the information flow in a time-shared common equipment system and some typical items of equipment needed in a PCM system. 1. In one trial system 23 channels are provided, the 24th being used for synchronisation. 2. The scanner and distributor are shown as mechanical devices which, in practice, are electronic. 3. An extra position carries signalling. In one trial system synchronisation and signalling are carried alternately. 4. Synchronisation involves keeping the wiper in step with that on the scanner.

In the laboratories of British Telecommunications Research Ltd at Maidenhead, a PCM encoding and multiplexing terminal rackside, manufactured by the Automatic Telephone and Electric Company, receives a final series of tests. The equipment shown here is a complete 24-channel terminal including the full auto-auto junction signalling facilities.

Picture: Courtesy ATE.



A NEW TRANSMISSION SYSTEM *(concluded)*

Certain characteristics of the cable pairs on which the trial systems will be set up are at present being measured. From this information and that gained from the field trials it is hoped to be able to forecast the extent to which PCM systems can be applied to pairs within any cable without recourse to further measurements. The need to make detailed measurements before setting up systems would seriously reduce the attractiveness of PCM working.

The sampling, coding, decoding and synchronising functions of the PCM system will necessitate the precise operation of electronic circuits for which semi-conductor devices are very suitable (in a complete system about 1,000 inexpensive semi-conductors will be employed). The trials will enable the Post Office to assess the reliability of telephone circuits depending on continuous and simultaneous correct functioning of large numbers of such devices.

The chief advantage of PCM operation lies in the economic provision of high quality transmission where the bandwidth is available but the quality of the transmission path is poor or noise rate is high. The possibility of extending PCM working to both the trunk and subscribers' line networks has been foreseen for some time. In addition, since PCM techniques are similar to those used in certain types of electronic exchange, line and switching circuits may, in future, be designed as a single complete system.

As the first step, the forthcoming trials are designed to meet the more limited objective of assessing the chances of more fully exploiting the capacity of the existing audio cable network. Nevertheless, they will also provide valuable information on the possibilities of introducing PCM systems with other and wider applications.

THE AUTHORS

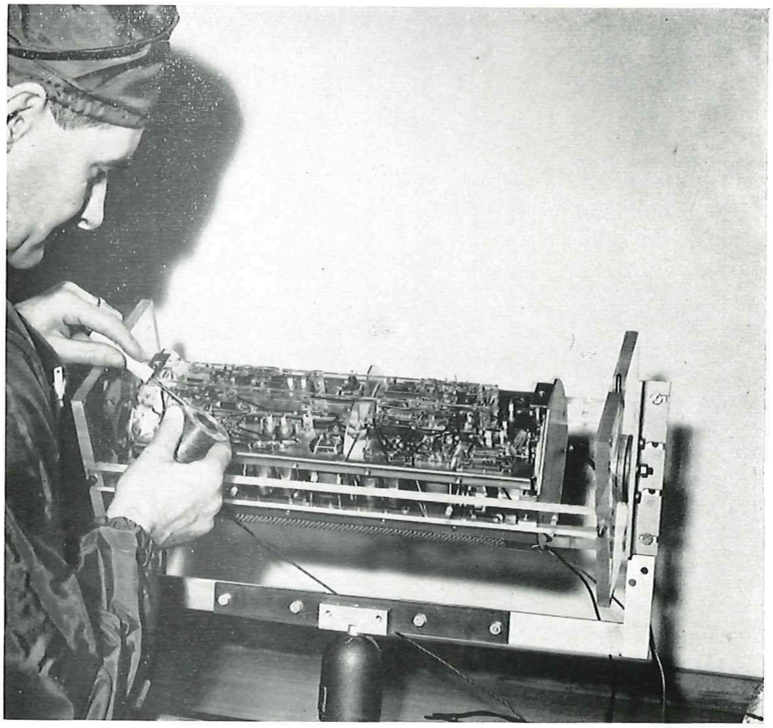
Mr. L. J. BOLTON, BSc, AMIEE, is a Senior Executive Engineer in the Main Lines Development and Maintenance Branch of the Engineering Department. He joined the Post Office in 1951 after spending ten years in Standard Telephones & Cables Ltd as a development engineer. For most of his time in the Department he has worked on new audio frequency transmission equipment but has recently been concerned with the development of high frequency line systems.

Mr. G. H. BENNETT entered the Post Office in 1939 as a Youth-in-Training at Aldershot Telephone Exchange. In 1950 he joined the Engineering Department and is now an Executive Engineer in the Main Lines Development and Maintenance Branch. He is mainly concerned with the development of PCM systems and coaxial line systems.

REPAIRING DOUBLE-ENDED REPEATERS

By B. K. MOONEY

The Post Office is now repairing its own double-ended repeaters. It is a delicate and exhaustive operation



A dismantled amplifier, mounted in a special jig to reduce the risk of damage, undergoes repair. Note nylon hat and overalls.

IN the early days of submerged repeaters, the Post Office carried out its own investigations and repairs of those found faulty quite apart from the services offered by the repeater manufacturers.

These early repeaters were of the single-ended type employing valves selected from standard commercial production. Twenty-one of them have now been repaired and some have been re-valved more than once.

In 1962 the repair facilities were expanded to deal with modern double-ended shallow water repeaters. Manufacturing conditions for these repeaters are rigidly controlled and in order to retain full confidence in a repaired repeater, conditions in the repair centre must be maintained to the same high standard. Special repair rooms have therefore been provided one of which has air conditioning plant to dehumidify the air and filter

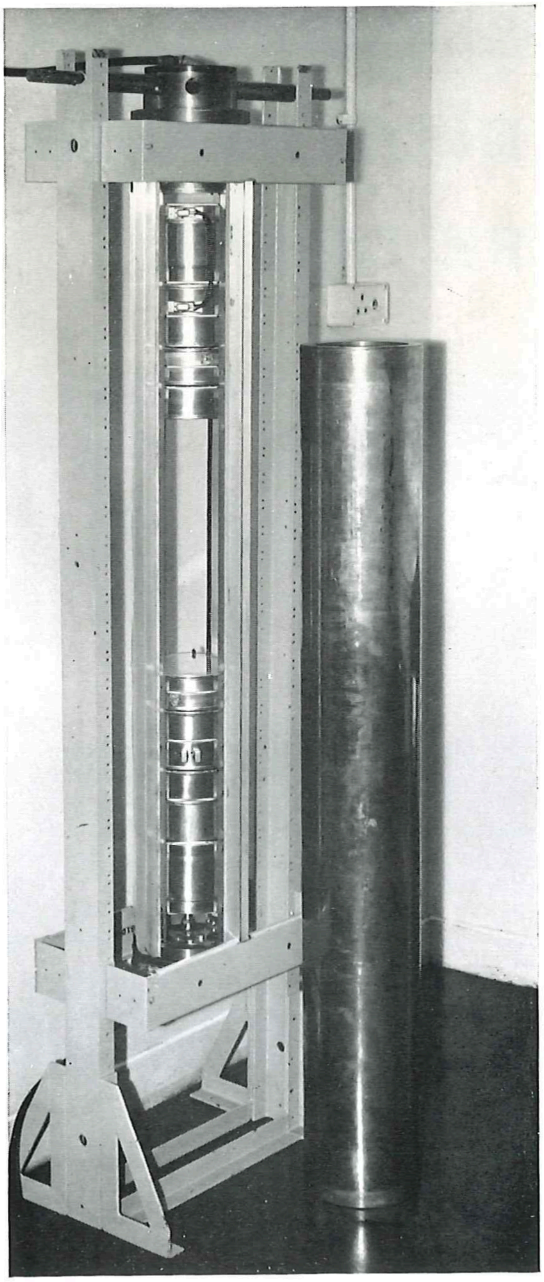
OVER

DOUBLE-ENDED REPEATERS *(Contd.)*
out all dust particles bigger than one 500,000th of a metre. This room, known as the clean area, is reserved for operations on the apparatus units of repeaters. To prevent contamination from dust and fibres released from normal clothing, all staff working in the clean area wear overalls, hats and overshoes made of nylon. Strict control is maintained over all materials and test equipment brought into the clean area.

The double-ended repeater housing is a steel cylinder, with a cable entry at each end, capable of withstanding pressures of up to four tons a square inch. The apparatus unit is sealed in by a steel bulkhead at each end and the cable passes through a pressure-tight gland to connect to the internal apparatus unit. In the earlier designs the bulkheads were brazed into the housing, but later types are fitted with demountable bulkheads in which the pressure seal is achieved by means of neoprene rings in grooves held in position by petroleum jelly under pressure in the periphery of the bulkhead. Special jigs are used to remove and fit the bulkheads.

When a repeater is repaired the bulkheads are removed and the hermetically sealed brass cylinder containing the apparatus unit is withdrawn and thoroughly cleaned. Only this sealed unit is taken into the clean area where the brass cylinder is removed to gain access to the apparatus unit which is then subjected to full electrical tests to prove and locate the fault. Every effort is made to establish the cause of the fault before any wiring or components are disturbed. When the faulty part is found it is removed from the apparatus unit and tests are made on the remaining units to ensure that their performance is exactly the same as when they were first made. Special jigs support faulty items undergoing repair so as to provide the best working positions and reduce the risk of accidental damage.

Replacement components are very carefully checked and measured over a long period and only those giving consistently stable results are used. The repaired unit is subjected to the same electrical tests as during manufacture. No attempt is made to modify or improve a repeater unless there is a very real justification for such action. When the tests are completed the apparatus unit is reassembled, power supplies are connected and test signals applied. After comprehensive tests to ensure that the whole unit has the same performance as when new the input and output signals are



The internal apparatus unit, mounted in its test rack, with the brass cylinder alongside and the amplifier removed for repair.

After being repaired the amplifier unit is put through a series of stiff tests.

continuously recorded for two weeks as a further check that performance is satisfactory.

The apparatus unit is replaced in its brass cylinder and after dry nitrogen has been passed through for 24 hours to extract all moisture the cylinder is sealed. The sealed unit is then taken to the mechanical assembly area where it is rehoused and the bulkheads pressure tested. Continuous recording tests are carried out for a further 12 weeks and if the results are satisfactory the repeater is stored for future use as a replacement.

The first repair of a double-ended repeater was completed early this year and a second repair is at an advanced stage. Both were fitted with demountable bulkhead housings.

THE AUTHOR

Mr. B. K. MOONEY is a Senior Executive Engineer in the Lines Branch of the Post Office Engineering Department. He entered the Post Office in 1930 as a Labourer in the Engineer-in-Chief's Training School. For the early years of World War Two he was loaned to Plymouth Area but returned to Lines Branch in 1941 to work on coaxial and carrier maintenance. Since 1949 Mr. Mooney has been associated with submerged repeater inspection at contractors' works and has participated in all British and European submerged repeater scheme lays and repairs.

BIRTHDAY HONOURS

Lieut-Col A. T. J. Beard.

Mrs. Doreen Blanche.

Fifteen members of the Post Office telecommunications staff received awards in the Queen's Birthday Honours. **Lieut. Col. A. T. J. Beard,** MBE, ERD, Telephone Manager, Nottingham, received the OBE, **Mr. W. Swanson,** Deputy Inspector of Radio Services, the ISO, and **Mr. A. F. Dowling,** MBE, TD, Chief Telecommunications Superintendent on loan to the Treasury, the MVO.

Three received the MBE. They were: **Mr. E. S. Russell,** Chief Telecommunications Superintendent, External Telecommunications Executive; **Mr. E. G. Lloyd,** Executive Engineer, Post Office Headquarters, Northern Ireland, and **Mr. B. H. Moore,** Assistant Engineer, Long Distance Area.

The BEM was awarded to **Miss N. V. Johnson,** Chief Supervisor, Salford; **Mrs. D. Blanche,** Asst. Telephone Mechanic, Cwmcarn; **Mr. R. W. Robb,** Technical Officer, Fort William; **Miss V. E. Hope,** Chief Supervisor, Potters Bar; **Mr. R. Adams,** Chief Supervisor, Belfast; **Mr. M. W. King,** Technical Officer, Belfast; **Miss E. M. Trotter,** Asst. Supervisor (Telegraphs), Darlington; **Mrs. V. M. Howard,** Chief Supervisor, Guildford; and **Mr. C. C. Lowe,** Technical Officer, North Area.

DEVELOPMENTS IN DUCTS

By D. W. STENSON

A new kind of earthenware cable duct which the Post Office is trying out may revolutionise laying methods. The new ducts have important advantages over any other and, if the trials are successful, only one type, instead of the present range of five will need to be employed

TRIALS are being carried out with a new type of earthenware cable duct which can be more quickly and easily laid and is likely to lead to radical changes in the long established method of cable duct laying.

Two small trial multi-way installations using the new duct have been established—an 18-way duct under a well used works entrance and a six-way duct below a normal class A suburban road. The results so far achieved are very satisfactory.

The story of this latest development goes back some 60 years since when ducts made of earthenware have been almost exclusively used in this country for carrying underground cable. Earthenware ducts have many engineering advantages over any other type. They are, for example, cheap and relatively easy to install and long lasting. In addition, their glazed surface enables cables to be pulled through the ducts very easily and without damaging the cable sheath or subjecting the cable to too much tension. The earthenware body is also sufficiently strong when buried at reasonable depths to withstand normal traffic loads without being strengthened by concrete.

The new duct joint (foreground) showing the sealing ring and plastic socket. Behind it, the standard Stanford composition joint of the present Duct No. 5.

Part of the six-way nest of the new duct built in a pyramid formation under a suburban roadway. The result of this trial so far is very satisfactory.

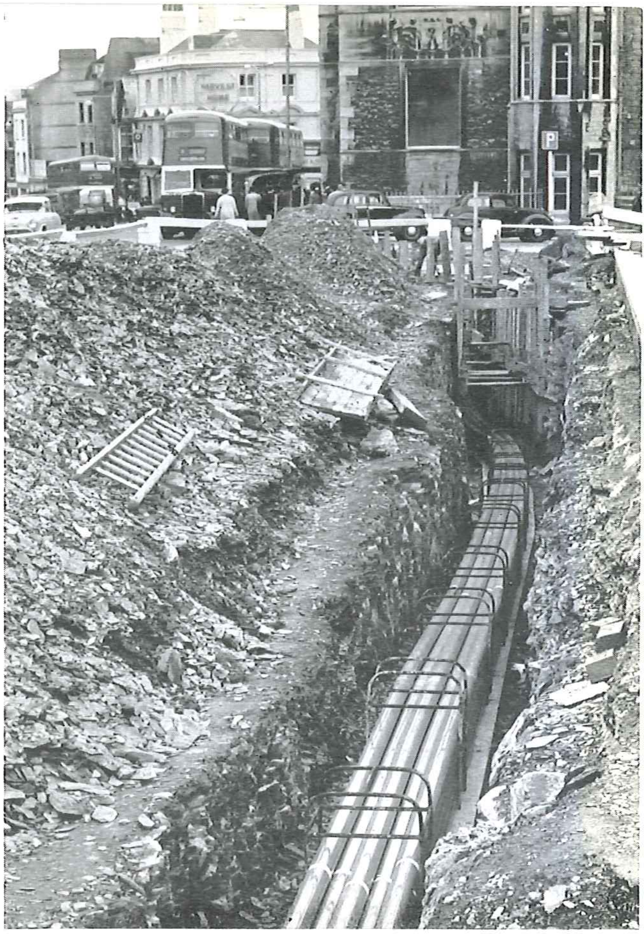
On the other hand, earthenware ducts are heavy and costly to transport, susceptible to damage in transit and require a high standard of jointing to make them watertight.

Cable ducts are also made of other materials, for example, of steel when greater mechanical strength is needed, of asbestos cement for small local cables or, embedded in concrete, as multi-way ducts. In recent years others made of pitch fibre have been used mainly as an alternative to asbestos cement and single-way earthenware pipes in large concrete nests. The design and construction of earthenware duct tracks depends on a number of factors such as the need to disturb the soil as little as possible and to keep settlement to a minimum. This creates no problem when either single-way or multi-way earthenware ducts are installed since satisfactory power compaction techniques can be used to restore the replaced soil to its original condition. However, since the single-piece multi-way earthenware duct is manufactured only in sizes up to nine ways and this, in larger towns, is insufficient for Post Office requirements, more than one multi-way duct often has to be installed in a trench. On these occasions it is difficult completely to compact the soil immediately around the ducts without using stabilising or strengthening materials. Generally, the number of multi-way ducts in a trench is restricted to four to provide up to 36 ways, although 18 ways are seldom exceeded. When building larger nests it is desirable and often more economic to install a number of single-way pipes with a concrete surround, but this form of nest is rarely justified for less than 18 ways.

The Post Office has carried out a number of experiments in the past few years with cable duct made of plastic materials—one of polyethylene and the other of PVC. Since polyethylene is a rather soft substance a sufficiently rigid duct could not be obtained without increasing the wall thickness, and hence the cost. However, pipe made of polyethylene was found to be a suitable alternative to the smaller wrought iron or mild steel service pipe used for feeding small cables up to subscribers' premises and was introduced in 1961 as Duct 100. It is much easier to install than wrought iron duct and costs much less.

Although unplasticised PVC is a much more rigid material and a thinner wall will give an adequately strong pipe, a PVC duct of sufficient thickness to withstand direct burial in the ground

OVER



During recent trials with PVC duct, an 18-way, closed formation track was laid in Plymouth. Above: The PVC track before the walls and roof were concreted. Below: Vibrating concrete round the PVC pipes.

Above: A workman places spacers over the PVC ducts so that they can later be built into a nest. Below: Pressurising the ducts of a 36-way formation nest before the concreting operation is carried out.

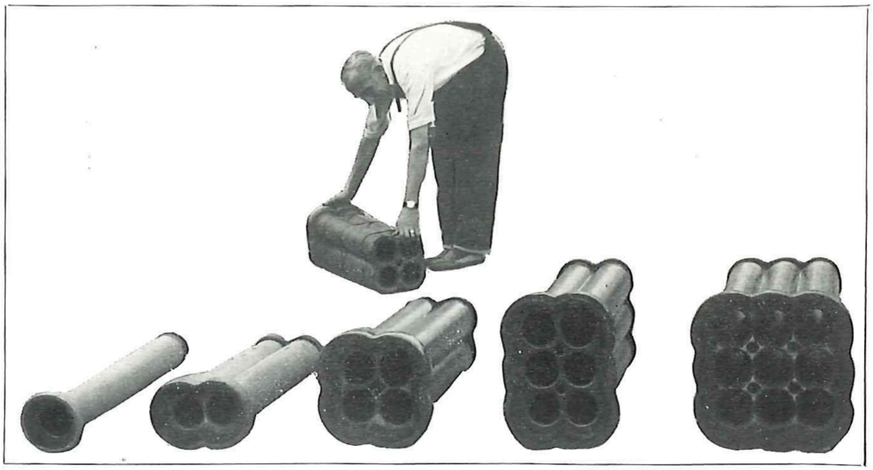
DEVELOPMENTS IN DUCTS *(Contd.)*

would at present be too expensive. However, examination suggested that pipes with thinner walls and surrounded by concrete to provide the strength might be the answer. Trials carried out with such ducts proved that although they were strong enough to be handled they were too easily deformed when being installed in concrete ducts by the normal method which involves the duct layer walking over a completed layer of duct before the concrete is completely set. A technique was then developed in which the ducts were installed in the trench by using spacers to hold them into position and then pouring concrete into the surrounding spaces in one operation. The early experiments with this technique in which pitch fibre ducts were used showed sufficient promise to justify further tests with PVC.

At about the same time the French were carrying out successful experiments with closed formation PVC ducts which promised considerable financial savings. In this system the ducts are closely assembled in the centre of a concrete surround instead of being spaced and separately surrounded by the concrete in the final nest, so that each is supported by adjacent ducts, except the outside ones which are supported by the surrounding concrete walls, roof and base. They are so closely assembled that little or no concrete passes into the spaces between them. This method of assembly reduces the width of the trench and the amount of concrete required and is therefore cheaper.

The French system has some disadvantages. For example, during cabling operations, the nest within the concrete can become deformed and may be damaged if stresses are too severe. Initially, cost and the experiments of the French engineers suggested that an 0.040-inch thick wall duct would be satisfactory. However, subsequent experience showed that such duct could be used only in the closed formation for substantially straight tracks and formations no bigger than 24 ways.

Another practical problem arose when installing these ducts because of the need to maintain them under air pressure during concreting operations so as to avoid possible deformation and consequent loss of cable space. Since then, reductions in the price of PVC have allowed the wall thickness to be increased to 0.060 inches. The greater stiffness of this duct has the important advantage that



The standard range of Post Office earthenware self-aligning duct. From left to right: Ducts Nos. 5, 6, 8, 9 and 10.

pressurisation is no longer essential during construction. Trials of PVC ducts have shown that very satisfactory duct tracks are obtainable. Cabling tensions are comparable to or even slightly better than those experienced in normal earthenware tracks. The PVC track is also inherently watertight and since the duct is flexible its route can easily be changed to avoid obstructions. Using air pressure and a simple piston-like device, it is very easy to pass a line through the duct before cabling—a much less laborious task than pushing cane or steel rods through the duct which has to be done in normal earthenware tracks.

PVC duct suffers from several disadvantages, however. Longer lengths of open trench are necessary to install the ducts underground and to pressurise them and the concrete takes a long time to set before the trench is filled. As a result, the cost of laying PVC ducts is higher than is theoretically obtainable. Nevertheless, some progress has been made and tracks leading into most new exchange buildings are now standardised in PVC. As further developments take place PVC may also be used for normal street tracks larger than 18 ways and may even prove to be economic for burying single ways direct into the ground without any concrete surround. The satisfactory outcome of the trials with PVC duct persuaded Post Office engineers to examine the possibility of applying some of the benefits to earthenware duct. As a result, trials are now being held with earthenware ducts which have a special uni-diameter joint with a plastic sleeve fixed to one tapered end of the earthenware barrel and pushed over an inset ring of rubber or plastic at the tapered spigot end. The new joint allows a wide variation in alignment between adjacent ducts and, although not completely watertight it considerably reduces the chances of silting and water penetration. It also enables the ducts to be nested closely together with the minimum amount of soil as a bedding material between them. For nests of up to 18 ways the new ducts can be built in pyramids or in the usual box formation with a small diameter plastic pipe between each four adjacent ducts to fill the large spaces and help to lock the formation. Laboratory tests have shown that both formations are sufficiently strong when installed at normal depths even without bedding material between the ducts.

The new experimental earthenware ducts possess a degree of flexibility in formation comparable with that attained by PVC ducts and have the important advantage that only one type would be necessary instead of the present range of five earthenware ducts, thus giving greater flexibility to the field engineer in his day to day planning of duct works and easing the problem of annual forecasting.

However, since the long-term effects of subsidence and soil movement are not yet fully available, it is too early to predict the final form which cable ducts will take.

THE AUTHOR

Mr. D. W. STENSON, BSc(Eng), joined the Post Office in 1943 as a Youth-in-Training in the Bedford Telephone Area, subsequently becoming a Technical Officer. In 1949 he was transferred to the External Plant and Protection Branch of the Engineering Department as Assistant Engineer. Since 1959, as an Executive Engineer in the same Branch, he has been concerned with the development and other aspects of ductwork, flexibility units and allied items.

SPEEDING THE SEARCH FOR UNDERGROUND CABLES

By D. E. KENNARD
and G. W. THOMAS

It is smaller, cheaper and lighter—but the new underground telephone cable locating apparatus does the job much more efficiently, speeding the work and cutting down on costs

NEW and more efficient apparatus is now being used by the Post Office to locate underground telephone cables. Much smaller and lighter, easier to handle and cheaper to manufacture than its predecessors, the new apparatus consists of a miniature search coil, transistorised oscillator and amplifier and a lightweight earphone.

The excellent magnetic properties of the new search coil—called the Search Coil No. 2A—are achieved by winding 6,000 turns of wire around a metal core, and the complete unit is enclosed in polythene to make it waterproof and very robust. Although the new coil is only seven inches long, two inches high and one inch wide, it produces about the same performance as the 2 ft 3 ins-square wooden-framed coil which it replaces.

The new transistorised oscillator, which is operated by two internal dry batteries, has an audio output of 1,000 cycles a second and an output power of 0.5 watts. It can be adjusted to produce pips of tone which can be recognised even when nearby electric services produce a great deal of noise. The output power is much higher than the power level of the normal tones on cable pairs, so that a good radiated signal can be obtained from cables buried many feet below the surface.

The signal induced into the search coil is amplified by up to 3,000 times by the new transistorised amplifier and is then fed into the earphone. The amplifier, which has a volume control and is operated from an internal dry battery, is of a similar type to that used by jointers when identifying cable pairs.

When locating underground cable tracks with the new apparatus, the oscillator is connected to a metal part of the cable—either to the sheath of lead-covered cables, the aluminium screen of polythene-covered cables or to a number of conductors bunched together in any type of cable. The far end of the metallic path is earthed—either to an earth spike or plate buried in the ground or to an existing earth system which is not connected directly to the cable—so that a signal current flows along the cable and returns to the oscillator by way of the earth. This current sets up an electro-magnetic field which radiates from the cable and can be detected by the search coil held close to the cable route. The output of the search coil is then amplified to produce a tone in the earphone.

The search coil has to be rotated to find the direction of the maximum signal in much the same way that a portable radio set with an internal aerial has to be turned towards the radio station to pick up the strongest signal. When the coil is held directly above the cable track it receives a maximum signal which indicates the exact position of the track to within a foot or so. To obtain a more accurate position to within an inch or two, the coil is held horizontally to detect the position of minimum tone. To measure the depth at which the

CONTINUED OVERLEAF

THE NEW.
Locating an underground cable with the new apparatus. Note the transistorised oscillator and earth spike at the joint box and the miniature search coil.

THE OLD.
The same task is carried out with the obsolescent apparatus which includes a large and cumbersome search coil.

SEARCH FOR CABLES *(Contd.)*

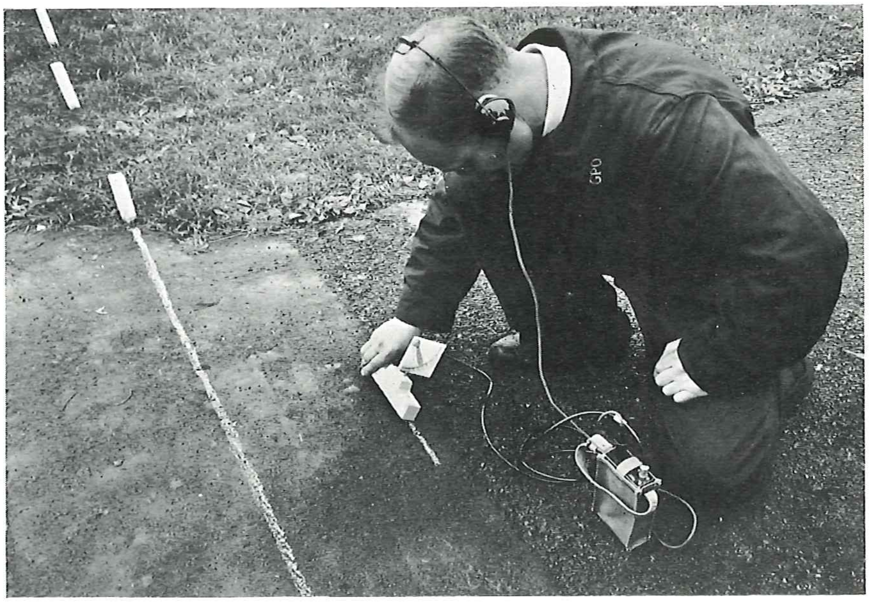
track is buried, the position of the track is first marked on the ground, the coil is then fitted with an inclinometer-type depth indicator and both are moved a foot or two away. When the coil is tilted to find the angle of minimum tone the pointer on the scale of the indicator shows the exact depth of the cable.

Why does the Post Office have to search for its own underground cables? It is true that cables rarely become lost since detailed records of them are usually available. Sometimes, however, insufficient information is to hand and on such occasions, to save the expense of digging holes to confirm the position of a cable, search apparatus is brought into use.

A large part of the telephone network consists of underground cables which either connect subscribers to exchanges or inter-connect different exchanges. These cables are almost always drawn into hollow conduits or ducts laid in single or multi-way formations below the surface of a road or pavement, or beneath a grass verge. The ducts provide space for additional cables to be inserted to meet future demands for telephone service. When a large number of cables is to be laid under city streets it is sometimes more convenient to construct subways or tunnels to house both the Post Office cables and those for other services, in which case there is no need to use cable-search apparatus.

In rural areas or on housing estates, however, where very little increase in demand for telephones is expected, distribution cables are sometimes buried directly into the ground without being laid in ducts. It is mainly these and the smaller cables which leave the main routes which the Post Office often has to locate when, for example, urgent engineering work has to be carried out close at hand and when more detailed records are required or need to be confirmed or brought up to date. In addition, cable tracks have to be located occasionally to repair cable-sheath faults or broken sections of duct, or to clear blockages caused by silt or tree roots which prevent cables being pulled through a duct route.

Since the cost of excavating in roadways and footpaths is high, cable tracks must be located accurately. When excavations are made in inexpensive pavings or grass verges, prolonged digging can be both tedious and unproductive. In addition to the time and effort spent in digging the hole, space often has to be found elsewhere for the removed soil and then, after the work is completed and the soil is replaced, the surface has



Measuring the depth at which a cable track is buried. The search coil is tilted to discover the angle of minimum tone and the indicator shows the exact depth.

to be restored to its original condition. The cost of such work varies, of course, with the locality, type of surface and soil and the size of the task. Typically, however, the cost of excavating soil is between £1 to £2 a cubic yard; of reinstating reinforced concrete roads, between £4 to £5 a cubic yard; whilst for reinstating grass verges, including reseeding, the cost is between 5s and 10s a square yard.

The new apparatus will help to reduce these excavation costs as well as play an important part in speeding the work involved in searching for underground cables.

THE AUTHORS

Mr. D. E. KENNARD, AMIEE, is an Executive Engineer in the External Plant and Protection Branch of the Engineering Department.
Mr. G. W. THOMAS is an Executive Engineer in the Subscribers' Apparatus and Miscellaneous Services Branch.

"TAKE TWO PIECES OF WIRE"

Sometimes underground cable tracks are located by the age-old divining rod method in which two pieces of stiff wire are used, each between two and three feet long and with one end of each bent at right angles to form short handles. The diviner holds the handles so that the longer sections of wire are about a foot apart and project forward, then he walks slowly over the ground to be searched. As he nears the cable track the two rods swing inwards and when immediately over the track they take up a position parallel to it.

The success of this method depends on the diviner's powers of concentration and skill, for although almost everyone can obtain some reaction from divining rods only very few acquire sufficient ability both to use them properly and to interpret their reactions correctly.

★

CHANGES AT THE TOP

THE *Journal* offers its congratulations to Mr. Alan Wolstencroft, CB, who takes over as Deputy Director General of the Post Office in succession to Sir Robert Harvey, KBE, CB, on the latter's retirement.

Mr. Wolstencroft, who is 50, joined the Post Office in 1936 as an Assistant Principal after obtaining a first in both parts of the Classical Tripos at Cambridge University. After serving throughout World War Two in the Royal Engineer's Postal Section, most of the time overseas, Mr. Wolstencroft returned to the Post Office and in 1949 was promoted to Assistant Secretary. In 1955 he became Under Secretary.

While Assistant Secretary he was successively in charge of branches responsible for overseas mails, overseas telegraphs and broadcasting. In 1954 he was seconded to the Independent Television Authority with which he served as its first Secretary and was responsible for a great deal of the detailed work involved in setting up the ITA.

As Under Secretary, Mr. Wolstencroft was at different times in charge of the Personnel Department, the Postal Services Department and the Radio Services Department. While Director of Postal Services he played a leading role in the international postal world as Chairman of the Executive and Liaison Committee of the Universal Postal Union. As Director of Radio Services he was responsible for the work associated with the Pilkington Committee on Broadcasting and the Act implementing the Government's decisions.

Sir Robert Harvey, who retires from the Post Office to become Vice-chairman of the Management Committee of the Printing, Packaging and Allied Trades Research Association, joined the Post Office in 1926 as an Assistant Principal and became Chief Superintendent of the London Postal Service in 1934. After serving at the Imperial Defence College and at the Treasury, where he spent most of the war years, Sir Robert was appointed Under Secretary in 1946 and, the following year, became Regional Director of the Home Counties Region. He was appointed Deputy Director General in 1955.

The new Director, Radio Services Department is **Mr. H. G. Lillicrap,** formerly Deputy Director of Finance. He joined the Post Office in 1936 as a probationary assistant engineer and spent most of his first ten years at the Dollis Hill Research Station, moving to the Radio Branch of the Engineering Department in 1947. He was Deputy Director of the External Telecommunications Executive from 1958 to 1960.

WITH MONARCH OFF PORTUGAL

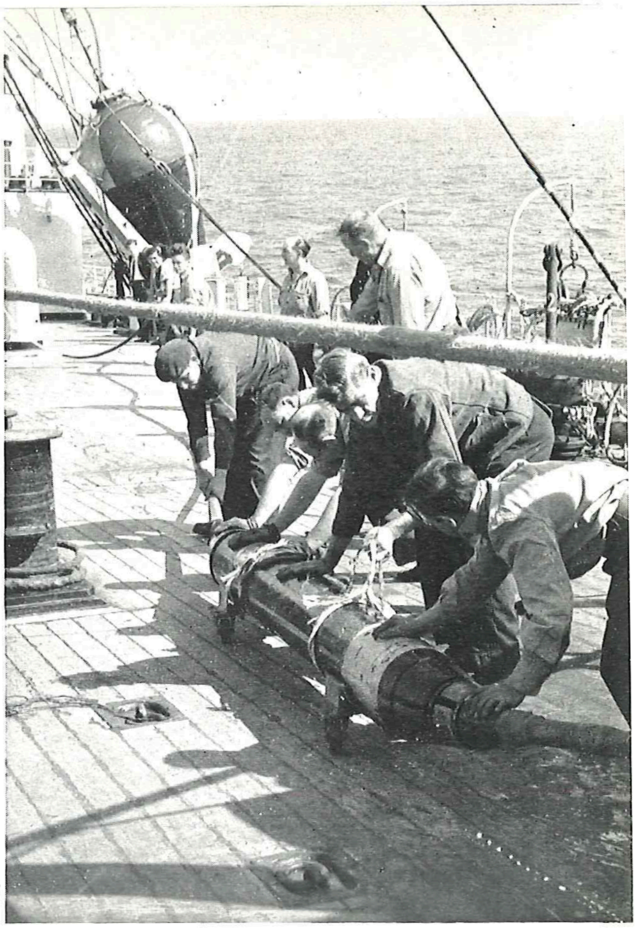
Veteran cable-hand J. G. Lowe guides the cutting knife of a flatfish grapnel into the cable. Seconds later 45,000 feet of cable was firmly held in the Research Branch's new type cable stopper.

A repeater is being recovered from 3,000 fathoms during the trials with the new cable.

THESE pictures show the Post Office cable ship, HMTS *Monarch*, and some of her crew in action off Portugal recently during trials carried out with a new type of lightweight submarine cable.

During the trials *Monarch* laid and retrieved considerable lengths of the new Mark Two white-polythene covered submarine cable—a development of the type used on CANTAT and COMPAC—which has been produced by Post Office engineers at Dollis Hill in conjunction with the manufacturers, Submarine Cables Ltd.

The new cable provides a wider bandwidth, and therefore, more circuits than the Mark One cable. It is so constructed that the possibility of cross-talk is eliminated.



Some of *Monarch's* crew haul a repeater aboard. The new Mark Two lightweight cable, which is covered in white polythene, will be able to provide more circuits than the present Mark One.

Mud from the bottom of the ocean is hosed off the end of the repeater casing.

A Year of Much Achievement

This is the new telephone exchange at Preston—one of many telecommunications buildings completed in the past year. To cater for the growth of the inland service the building programme is being speeded and expanded.
Picture: Courtesy, Arthur Winter.

OPERATIONALLY and financially, the telecommunications services enjoyed a year of solid, all-round achievement which foreshadows even better things for the future.

This is the tenor of the Post Office Report and Accounts, 1963-64 *which records that during the* 12 *months ended on* 31 *March,* 1964, *there were large increases in the number of inland and overseas telephone calls, considerable advances in modernisation and automatisation and a rise in profits from* £20.2 *million in* 1962-63 *to* £38.5 *million.*

Here are the details of the year's achievements:

INLAND SERVICES

Telephones

● The number of telephone calls rose from 5,295 million in 1962-63 to 5,724 million. There were 5,100 million local calls (an increase of 7 per cent on the previous year) and 624 million trunk calls (an increase of over 14 per cent).

● The number of calls to the Information Services increased from 110 million in 1962-63 to 124 million.

● Demand for telephones and the rate at which they were provided were both at record levels. Demand, at 566,000 exchange connections, and supply, at 555,000 were both nearly one third higher than in the previous year.

● The number of telephones, including extensions, at 31 March, 1964 was 9.4 million (including 75,000 call offices)—compared with 8.9 million in March, 1963.

● In spite of the higher demand the waiting list did not increase.

● 85 more manual exchanges were converted to automatic working and 198 automatic exchanges were extended. The number of manual exchanges at the end of March, 1964, had been reduced to 533 and automatic service was available to about 88 per cent of all subscribers. Manual exchanges are being converted to automatic working at the rate of about two exchanges a week. By 1968 there will be only 150 manual exchanges left in the country and 98 per cent of all subscribers will have automatic service.

Recording a forecast for the London Weather Service. The number of calls made to the Information services in the past year reached 124 million.

● Another 335,000 pairs of wires were provided by new underground cables from exchanges to subscribers' premises and 5,150 more trunk circuits over 25 miles long and many shorter distance circuits were brought into use.

● The Subscriber Trunk Dialling system was further expanded and by the end of March, 1964, there were 688 STD exchanges, serving about 43 per cent of all subscribers. By March, 1964 about five million trunk calls were being dialled every week. It is estimated that during the past year STD subscribers saved about £13 million compared with what they would have paid for the same calls under the old system.

● Further progress was made on research into and development of electronic exchanges. Development resources will be concentrated in the immediate future on the space-division electronic system.

● The microwave radio system to cater for both telephone and television requirements is going well ahead. About 100 stations have been or are being provided and another 25 will be added by 1968.

● To reduce the load in London due to the rapid increase in trunk calls, three new trunk switching centres are being opened in 1964 at Cambridge, Tunbridge Wells and Reading. They will handle much of the traffic to and from the Home Counties which at present circulates through London.

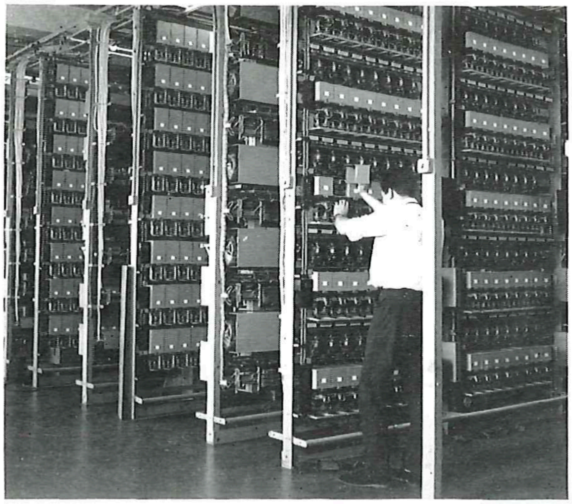
● A number of new items of subscribers' apparatus were issued during the year and development work is well advanced on a number of others—including a repertory dialler; a more compact type of telephone with an illuminated dial and giving a tone calling signal instead of the traditional bell ring; a new floor-standing manual switchboard for ten exchange lines and 50 extensions which may be expanded up to 40 exchange lines and 200 extensions. Development work is also being carried out on a push-button telephone.

Telegraphs

● Traffic in the inland telegraph service continued to decrease and the number of messages handled fell from 13.9 million to 11.7 million.

● The telex service grew steadily. The number of subscribers at the end of March, 1964, rose to 12,400 compared with 10,300 at the end of March, 1963, and the number of calls went up from 10 million in 1962-63 to just under 12.7 million.

OVER



An engineer testing part of the new Trunk Switching Centre at Reading. Other similar centres are being opened at Tunbridge Wells and Cambridge. The equipment at the new centres will cost £2 million.

The shore-end of the Sydney to Auckland section of the COMPAC Cable is floated ashore at Bondi Beach from the Cable and Wireless Company's cable-ship *Retriever*. SEACOM, the third stage in the Commonwealth Cable Scheme is now under way.

OVERSEAS SERVICES

Telephones

● The number of telephone calls exchanged between Britain and other countries went up from 8.8 million in 1962-63 to 9.8 million. The number of calls in the short-range telephone service with ships at sea also increased—from 148,000 in 1962-63 to 153,000.

● By the end of March, 1964, operators were able to dial telephone calls direct to subscribers in ten European countries and also to those in the United States, Canada and Australia. It is hoped that by 1966 operators will also be able to dial direct to subscribers in other countries, including New Zealand.

● International Subscriber Dialling—introduced in March, 1963, to enable London's STD subscribers to dial their own calls to most subscribers in Paris—has since been extended to France, Belgium, Switzerland, Western Germany and the Netherlands. By the summer of this year STD subscribers in Birmingham, Edinburgh, Glasgow, Liverpool and Manchester will be brought into the system and by early 1965 it is hoped to extend it to other European countries.

Cables

● COMPAC (the Commonwealth Pacific Cable) —the second link in the Commonwealth Cable Scheme—was opened in December, 1963. The next stage is the laying of the SEACOM (the South East Asia Commonwealth) cable which will connect with COMPAC in Australia and link that country with New Guinea, Malaysia and Hong Kong. This cable is aimed to be completed by 1966.

● The number of telephone calls exchanged between Britain and Australia and New Zealand since COMPAC was opened amounted by the end of March, 1964, to about 30,000—almost equal to the number exchanged in the whole of 1962-63.

● TAT-3, at 3,500 miles the longest trans-Atlantic cable yet laid, was opened for service in October, 1963

● An Anglo-German submarine cable—the first direct, large-capacity cable to be laid between the two countries—was opened for service in February, 1964. It is the first of six new submarine cables to be laid across the North Sea in the next few years.

Telegraphs

● Two important steps were taken in the year to speed and increase the handling capacity of the overseas telegraph service. The first was the setting up of a number of overseas telegraph area offices to serve most of the provinces and parts of London and which can exchange telegrams direct with a number of European countries. The second step was the introduction at Electra House, London, of a message relay unit serving a number of countries

outside Europe. The area offices, which are directly connected with this unit, can thus directly exchange telegrams with the countries concerned.

● The International Leased Telegraph service expanded rapidly and by the end of March, 1964 there were 115 leased circuits to Europe and 148 to other countries.

Ship to Shore Radiocommunication Services

● The coast stations handled 802,000 telegraph messages in 1963-64 (compared with 790,000 in the previous year) and about 14,000 weather bulletins, navigational and gale warnings. In addition, in conjunction with the Long-distance Radio Telephony Service, 160,000 radio-telephone calls were handled—an increase of about 4 per cent over the previous year.

Finance

● Total income from the telecommunications services was £342.7 million and expenditure £304.2 million, thus producing a profit of £38.5 million. After allowing for £5.2 million of income brought to account in 1963-64 but not proper to the year, the increase in profit over the previous year was about £8 million.

● The return on capital was 8.8 per cent compared with 7.2 per cent in 1962-63 and 6.6 per cent in 1961-62.

● The chief contributions to the profit came from trunk telephone calls (£33 million), exchange line and other rentals (£6 million) and inland private circuits (£5.6 million). There was a loss on local telephone calls of £9 million; on call offices of £4.4 million and on inland telegrams of £2.7 million.

THE TARGET IS 8 PER CENT

IN a chapter entitled *Financial Objective*, the Report says that the financial target for the Post Office is to earn an average return on its net assets of 8 per cent over the five years 1963-4 to 1967-68.

The adoption of this objective has important implications for forward planning. Planning can now proceed for some years ahead with reasonable assurance that, so long as the financial objective is achieved, programmes of expansion and modernisation will not be frustrated by arbitrary restrictions. "Achievement of the objective must mean that Post Office charges generally are economic and that it is right to meet in full what the public demand at those charges."

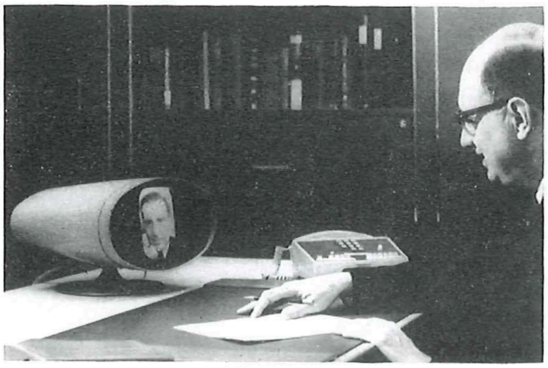
During the five years for which the financial target has been set, adds the Report, the Post Office plans to spend nearly £1,100 million (compared with £555 million in the previous five years) on expanding, improving and renewing its capital assets. "The greatest part of the investment will be in the inland telephone service, plans for which include the abolition of the waiting list and the expansion and complete automatisation of the system as rapidly as possible." Provision has also been made for the rapid growth in the overseas telecommunications services, including participation in a world-wide system of satellite communications.

* * *

PICTUREPHONE DEBUT

An experimental picture-telephone system which enables a caller to see as well as talk to the other subscriber, has been brought into service to link Washington, New York and Chicago.

The instrument, which is called the Picturephone, has been developed by the Bell Telephone Laboratories of America. Call charges between New York and Washington are about £5 10s for three minutes, compared with about 5s 9d for the same time on the conventional telephone service.



Mr. L. Meacham at his desk in New York, talks to (and sees) over the Picturephone, his colleague Mr. A. D. Hall. Both helped to develop the system.

NEW EXCHANGE BUILDINGS SAVE TIME AND MONEY

THE INTRODUCTION OF STANDARDISED PLANS IS SPEEDING THE COMPLETION OF TELEPHONE EXCHANGE BUILDINGS ACCOMMODATING MORE THAN 2,000 LINES. THE SYSTEM MAY ALSO BE APPLIED TO OTHER TYPES OF EXCHANGE BUILDINGS

By A. D. BRITTON

A NEW type of telephone exchange building housing more than 2,000 lines is springing up throughout the country. It is the single storey K-type building which, because it is designed to standardised plans, is quicker and cheaper to plan and is playing a valuable role in meeting the increasing need for more exchanges.

Until recently all telephone exchange buildings containing more than 2,000 lines were individually designed—an involved process requiring considerable expenditure of time and money on planning, both in the Post Office and the Ministry of Public Works and Building. Many drawings had to be prepared and checked for each building and the process normally took several months to complete. Now, however, standardised plans are immediately and always available.

Faced with a growing building programme, the Post Office examined possible ways of speeding the provision of exchanges and as a result decided on the introduction of a considerable measure of standardisation in planning. The variation in individual needs makes the development of completely standard buildings larger than the H-type (those housing between 600 to 2,000 lines) difficult and uneconomic to achieve but it was found possible to prepare a series of standardised plans for exchanges of over 2,000 lines (without a manual board) which could be generally adopted throughout the country.

In essence, the new K-type building consists of a main block—11 ft 6 ins high and constructed in building bays each 12 ft 8 ins long—which forms the apparatus room housing the switching equipment and main distribution frame. Linked to the main block in varying arrangements are standardised power and battery rooms at the front of the building, work rooms, welfare accommodation and maintenance control rooms.

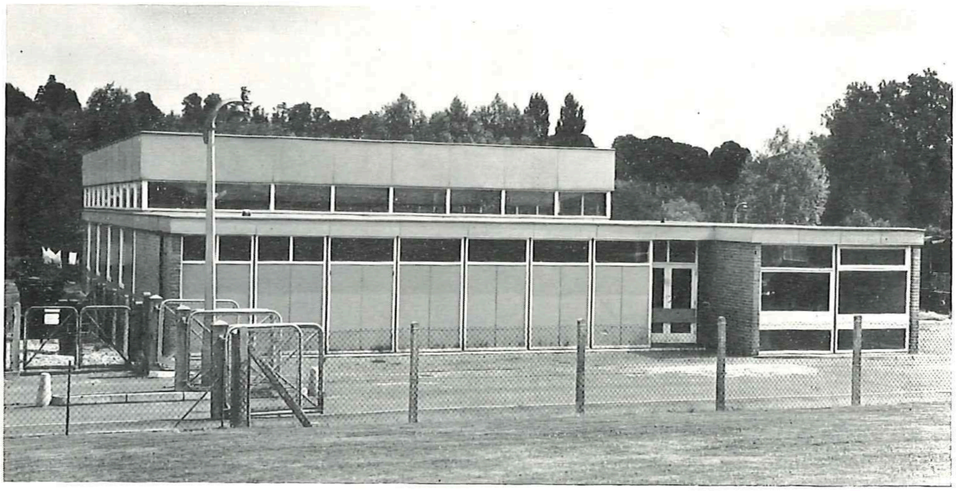
Five possible arrangements of the new type exchange building have been produced: the first for a telephone exchange (without maintenance control) of up to 5,000 multiple and junctions; the second for an exchange of similar capacity plus a maintenance control of up to six positions; the third for an exchange (again without maintenance control) of over 5,000 multiple and junctions; the fourth for an exchange with over 5,000 multiple and junctions and a maintenance control of up to six positions; and the fifth for an exchange with up to 5,000 multiple and junctions, maintenance

CONTINUED OVERLEAF

Planning of the new K-type buildings began in January, 1961.

The first of the new exchange buildings was completed at Leighton Buzzard in February, 1963. Since then four other K-type buildings have been completed. Twenty-two others are at present in course of construction and forty more will be completed within the next few years.

Left: The new K-type exchange at Beaconsfield, one of the first of the new range to be completed.



Right: The new K-type exchange at Berkhampstead which was completed in July last year.

Left: A typical H-type telephone exchange building at Chestfield in Home Counties Region. The H-type is about the size of a normal bungalow.

NEW EXCHANGE BUILDINGS *(Contd.)*

control of up to six positions and an office for an assistant engineer.

These arrangements will meet the requirements in most instances, but others could be developed if necessary. In some instances, however, particular requirements can be met only by separate individual designs.

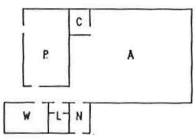
For operational efficiency the different blocks of the K-type exchange are arranged so that they can fulfil their functions to the best advantage. The work rooms, for example, open directly off the apparatus room and access to the welfare space is gained from the front of the building. The apparatus room can be enlarged by adding bays either in line or at right angles to the initial building, a temporary end wall remaining in place until the extension is completed. The workrooms and maintenance control rooms can also be easily extended. The welfare block is in two sizes, the larger being adequate for essential staff when the site is fully developed. Normal access for staff and equipment has been deliberately arranged at the front of the building so as to reduce the amount of expensive paving to a minimum, but where essential the yards are also paved.

The K range of new exchanges are of modern design and conform to normal accommodation standards. They have underfloor heating and are fitted with small ventilating units, thus obviating the need for a large heating chamber and fan room. Nor is a separate battery room required. Because of the recent introduction of large enclosed batteries they and the power plant and generating engine can be accommodated in one room.

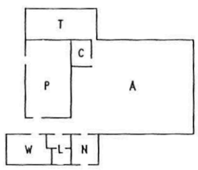
There is scope for further improvement in the designs of the new exchange buildings and a possible application of the principles to other types of exchange. At present, because the width of the site needed for the single-storey buildings is not always available, plans are being developed for a two-storey version of the K-type buildings and work is being carried out on a similar type of single-storey building for exchanges with a capacity of between 600 and 2,000 lines.

The design and construction of the new K-type exchange buildings were decided after close collaboration between the Post Office and the Ministry of Public Building and Works which controls the standardised plans.

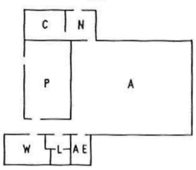
K1



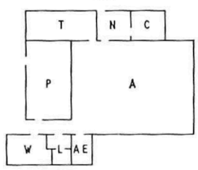
K1C



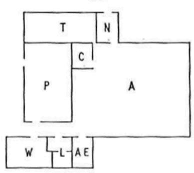
K2



K2C



K3



These diagrams show the range of the new K-type buildings. In all illustrations A stands for the apparatus room; C for the construction and contractor's room; N for the normal stock and workroom; AE for the Assistant Engineer's room; T for the test room; W, the welfare room; L, lavatories and lockers; and P, the power and battery room. Since these diagrams were drawn the K-I arrangement has been modified by lining up the welfare block with the rest of the main building.

THE AUTHOR

Mr. A. D. BRITTON, AMIEE, is a Senior Executive Engineer in the Exchange Equipment and Accommodation Branch of the Engineering Department. He joined the Post Office in 1927 as a Youth-in-Training in London and was employed for a number of years on exchange maintenance and construction duties before moving to Home Counties Region in 1940 as a Chief Inspector. Since 1945 he has been concerned with the planning and provision of buildings for telecommunications services, moving to the Engineering Department on promotion in 1955 and dealing with standards for engineering accommodation.

A NEW AND SAFER SAFETY BELT

By R. L. HEARSEY

The new safety belt, showing how the adjuster works. The belt has a minimum breaking strength of 5,000 lb.

A NEW safety belt which is stronger, more flexible and harder wearing than its two predecessors is being introduced for use by engineering staff when they work on poles or steel lattice masts.

The new belt—called the Safety Belt No. 3—is made of continuous filament terylene one-and-three-quarters of an inch wide. It is in two parts: a body belt with a double width of webbing at the back and a much longer pole belt which passes through a detachable anti-friction pad. The pole belt webbing has a minimum breaking strength of 5,000 lbs and the body belt webbing 2,500 lbs. The metal fittings, which are of the parachute type, can withstand shock loads, resist corrosion by sea water and are self-polishing.

The body belt, which is fastened by two rectangular metal fittings, is first adjusted to suit the individual and although this takes some time to complete, the adjustment rarely needs to be subsequently altered.

The pole belt is passed round the pole or mast, the snap hook being fastened with one hand if necessary, and the anti-friction pad is manoeuvred into position between the belt and the pole. The user can alter his distance from the pole without becoming detached from it by operating a self-locking sliding bar adjuster.

The new belt will replace both its leather predecessors: the Safety Belt No. 1 used for work on poles and the Safety Belt No. 2 for work on masts. Field trials have shown that the new belt is more easily handled because of the improved fittings and the greater flexibility of the terylene webbing material. Laboratory tests have proved that it is also stronger and more durable than the old leather belts and that there should be less difficulty in maintaining a uniform standard of quality.

Leather safety belts were used by the Post Office Engineering Department before 1933, when the present specification was written. In recent years, however, it has become increasingly difficult to obtain the very high quality leather required and since leather is inherently a variable material very close inspection has always been necessary to maintain the standard of quality. At the same time, other materials which have advantages over leather have become available and the advent of synthetic fibre webbing has now made it possible to produce an even better belt.

In designing safety belts a number of factors have to be taken into account. The strength of the belt must be adequate and its appearance must give the wearer confidence in it. The belt must resist wear and attack by chemicals and sunlight; it must require the minimum of maintenance, be possible to fasten or release the pole belt with one hand and be safely and easily adjusted.

Since safety belts are used in the Engineering Department primarily to prevent a man falling rather than to break his fall they are usually subjected to static loads and only rarely to dynamic shock. The sudden whip of a pole when the wires are cut could result in dynamic shock and in such an event the new terylene belt would be much less likely to break than a leather one. This factor, plus the high shock absorption and good resistance to degradation by light, heat and chemicals makes terylene a first choice as material for safety belts.

THE AUTHOR

Mr. R. L. HEARSEY joined the Post Office in 1943 as a Youth-in-Training in the City Telephone Area, subsequently becoming a Technical Officer at Regional Headquarters. In 1959 he was promoted to Assistant Engineer in the External Plant and protection Branch, Engineer-in-Chief's Office.

THE NEW FAMILY OF CORDLESS SWITCHBOARDS

By C. M. HALLIDAY

With the appearance of the PMBX No. 2/4A, the smart new family of small cordless switchboards is complete. This article describes them and the facilities they offer

The latest addition to the new family of cordless switchboards: the PMBX No. 2/4A. This apparatus is more reliable and easier to maintain than earlier models.

A NEW cordless private manual branch exchange, jointly developed by the Post Office and the manufacturers, was introduced for public service recently.

The PMBX No. 2/4A is the third and last of a new range of small cordless switchboards which incorporate new circuit designs, have greater reliability, are easier to maintain and provide better facilities than the older types they replace.

The first new cordless switchboard which was issued in 1961—the PMBX No. 2/2A—has three connecting circuits and a capacity of two exchange lines and six extensions. The second—the PMBX No. 2/3A, which became available in 1962—has five connecting circuits and a capacity of three exchange lines and 12 extensions. The PMBX No. 2/4A has seven connecting circuits and a capacity of four exchange lines and 18 extensions.

The new switchboards are made of modern materials and are of a new design. The Victorian-style dark wooden case which housed the old

switchboard equipments has been replaced by a plastic cover and metal keyboard matching the colours of the 700-type grey telephone used as the operator's instrument. The light grey cover is injection moulded and made of a new and very strong plastic material known as ABS (Acrylonitrile Butadiene Styrene) Co-polymer. It fits over a three-section metal chassis consisting of a key panel and a relay panel hinged on the base plate. The panels open outwards to allow easy maintenance access to the wiring and components. The key panel is finished with a dark grey, leather-grain and extremely durable coating of PVC.

The appearance of the panel is enhanced by the use of modern style keys and by affixing all the components associated with it so that the fixing is not seen from the front. The keys are much smaller than in the older type of PMBX and have comb-operated springs with twin contacts to give greater electrical reliability. The bulky indicators in the old-type switchboards have been replaced by lamps and small clear plastic lenses fitted immediately above the keys and designation strips.

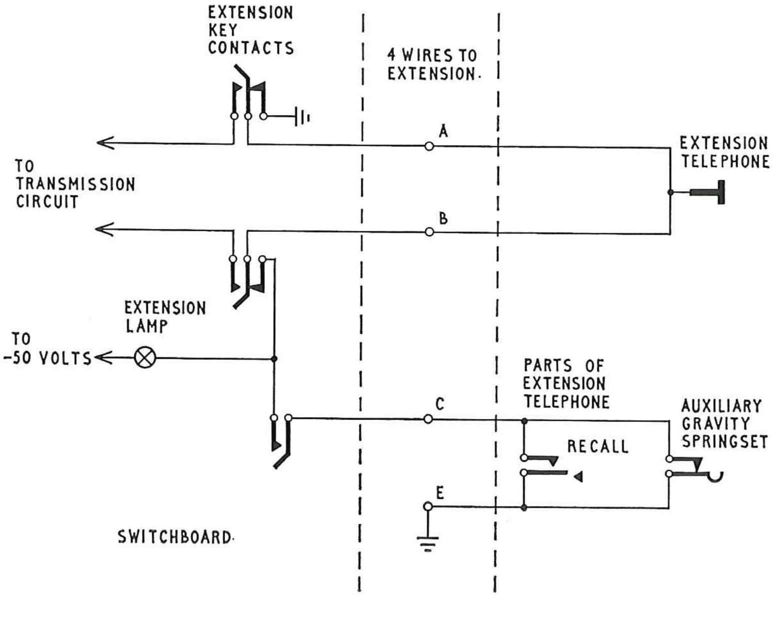
The two larger switchboards can have cyclometer type private meters fitted in the face panel immediately above the exchange line connecting keys, the normal designation strip being replaced by a narrower type. Meters can be provided for each line or there can be one meter switchable to any exchange line, when an associated button is mounted adjacent to the meter. Metering facilities for the smallest board are given by separate clock-type meters connected to the exchange lines.

The new switchboards are connected by means of a multi-way flexible cord terminating on a plug inserted into a jack which is linked to the permanent wiring of the installation. This allows a switchboard to be easily replaced if it is inconvenient to complete a repair with the switchboard in service.

A new lamp has been designed for all three switchboards, thus avoiding the need to use signalling relays in the extension line circuits.

An important new feature is the introduction of a four-wire extension circuit which obviates the need to provide supervisory relays in the connect circuits. Briefly, the extension circuit consists of a speech pair, a supervisory wire, and an earth. The extension normally calls the switchboard by applying the telephone loop to the speech pair and the lamp glows. When the operator answers, the extension loop is extended to the transmission circuit and the lamp is extinguished and connected to the supervisory wire. When a call is

OVER



This diagram shows the four-wire extension circuit which does away with the need to provide supervisory relays in the connect circuits.

An operator with the PMBX No. 2/2A on which exchange calls can be held by operating a key, thus enabling her to speak to an extension without being overheard by the caller.

CORDLESS SWITCHBOARDS *(Cont'd)*

completed and the extension clears, the earth on the fourth wire is applied to the supervisory wire by the closing of the auxiliary gravity springs and this causes the lamp to glow. Recalling the operator into an established call is effected simply by arranging for the recall switch contacts to apply an earth to the supervisory wire.

When providing more than two wires is uneconomic—for example, when extensions are routed in the local line network—a unit is provided to convert from four-wire to two-wire working. Equipment has also been designed to connect inter-switchboard and private circuits where a variety of signalling methods is employed.

THE AUTHOR

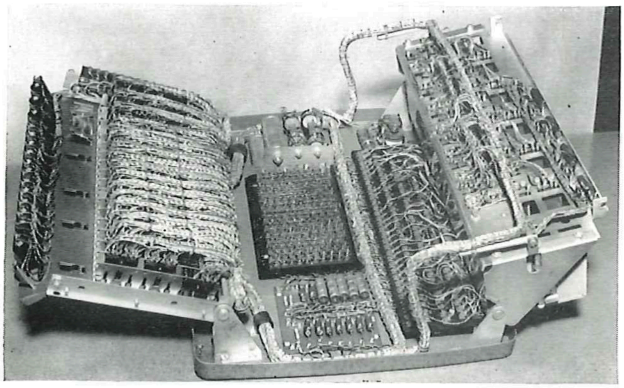
Mr. C. M. HALLIDAY, AMIEE, entered the Post Office Engineering Department in Scotland West Area as a Youth-in-Training in 1936. After service in the Royal Signals during World War Two, he was promoted to Assistant Engineer in Equipment Branch of the Engineer-in-Chief's Office. In 1959 he was appointed Executive Engineer in Subscribers' Apparatus Branch and has since been engaged in the design and development of PMBX equipment.

The new switchboards have been purposely designed to be operated in a similar way to the old cordless switchboards so that operators can readily adapt themselves. They will, however, have to become familiar with a number of new facilities. For example, on the PMBX No. 2/2A, exchange calls can be held by operating a key which allows the operator to speak to an extension without being overheard by the exchange line caller. On the other two new boards exchange calls are automatically held and when the required extension answers the holding circuit is disconnected. A lamp signal indicates that an exchange call is being held. A "call trap" is also provided so that an extension cannot be rung in error on a "follow-on" incoming exchange call if the operator has not cleared down the previous call.

On the PMBX No. 2/4A two other operating aids are included. The first is a free link signalling lamp system which indicates to the operator the next free connecting link to be taken into use. The second is an over-call circuit which permits a call to be answered if all the connecting circuits are in use.

All three new switchboards are normally

This is the PMBX No. 2/3A, the second in the family of cordless switchboards. It has five connecting circuits and a capacity of three exchange lines and twelve extensions.



This picture shows the PMBX No. 2/3A switchboard with its cover removed. This apparatus became available in 1962.

operated at 50 volts dc from a mains operated power unit instead of by power leads from the main exchange. A hand generator is no longer fitted and the ringing supply is obtained from a mains-operated frequency division unit which fits into the power unit and produces 25 c/s ac. Arrangements are made to ensure that exchange calls in progress are maintained in the event of a mains failure. Under these conditions an incoming call on the first exchange line rings the bell in the operator's telephone and the other exchange lines can be extended to selected extensions. Where the mains power is unreliable and the loss of extension traffic cannot be accepted the equipment is operated from a floated battery.

All three new switchboards have been enthusiastically welcomed by subscribers who appreciate both the additional facilities they provide and their smart modern appearance. The Post Office is now focusing its attention on the modernisation of the present range of smaller cord-type switchboards.

LOOKING AHEAD TO

REGISTER-CONTROLLED PABXs

By H. F. EDWARDS

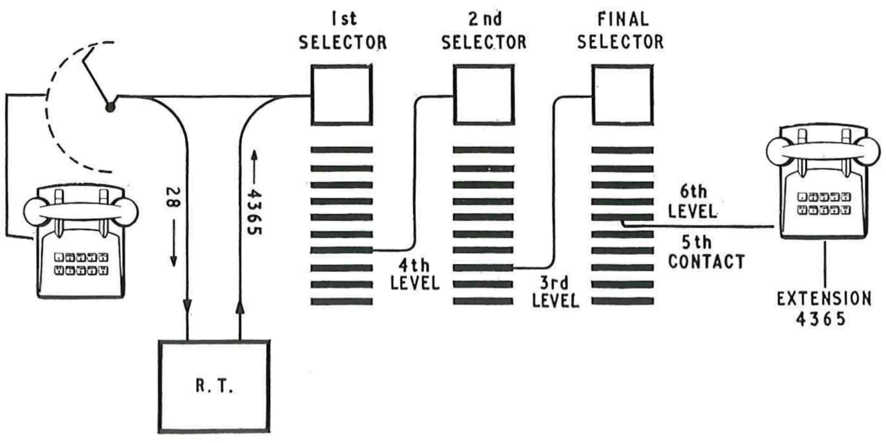
SOME automatic telephone switching systems, such as the "crossbar", require registers to control them. This makes them more complex and expensive than the simple Strowger, step-by-step system generally adopted for private automatic branch exchanges in this country, but register-control enables telephone users to enjoy certain facilities that are not otherwise possible.

Following requests by two big business firms—the British Petroleum Company and Barclays Bank—the Post Office is examining the possibilities of private automatic branch exchanges controlled by registers or register-translators to give business subscribers additional telephone facilities.

A register is a device which accepts the impulses from a telephone dial, or other form of number selection, and passes them on to the switching equipment. A register-translator puts the impulses into a different form. If, for example, the figures 28 are dialled, or signalled in some other way, from a telephone, a register-translator would register and translate them into the digits, say, 4365, which it would send forward in the form of signals suitable for operating the switching apparatus. Registers and register-translators are not new. They have been used for many years in director automatic exchanges, where they are known as directors, and on all STD calls.

The use of a register-translator on a PABX is new, however, and it has two main advantages. First, it permits the use of keysets, instead of dials, on the telephone and, second, it introduces the possibility of the telephone user keying or dialling a short code of two or three figures instead of the full telephone number to call someone with whom he or other extension users have frequent contact.

In the normal PABX the switching equipment is directly controlled by the rotation of the dial, so that if the figure 6 is dialled, six pulses are sent and a selector, or switch, in the PABX, "steps" six times and rests on its sixth level where it picks up a connection to another switch which will be ready to respond in the same way to the next figure



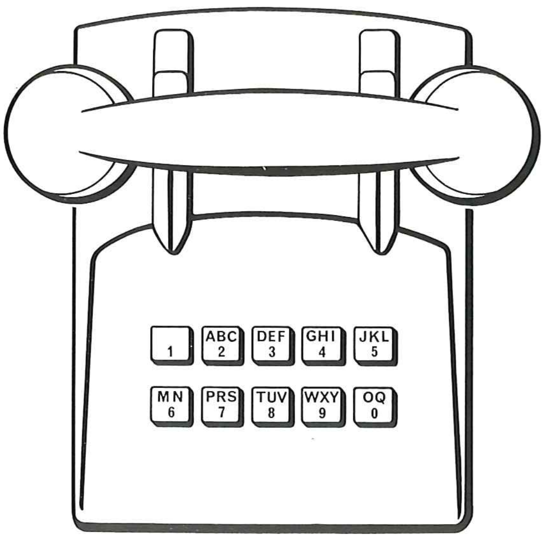
This diagram explains the short-code repertory facility. An extension user calling extension 4365 keys the code 28. The signals go into the register-translator which translates them into 4365 in signals of the kind a dial would give, and sends them into the PABX automatic selectors.

dialled. To call another extension on a large PABX four figures must be dialled, which takes about five seconds. To call a local number on the public exchange requires anything from five to eight figures, that is, the figure 9 followed by the telephone number, and these eight digits take about ten seconds to dial. It is, of course, very much quicker to punch out a series of figures on an adding machine where each figure requires only momentary pressure of a button. If the same kind of device, say ten push-buttons—one for each figure from 1 to 0—could be used on a telephone, eight figures could be punched out in about five seconds or even less.

It is also easier to press a button and release it than to make the series of part-circular movements required with a dial. Although dialling has probably become second nature to many people, it is something that has to be learned and performed with care. With push buttons it is difficult even for the novice to go wrong.

If push-button keys could be made to send the kind of pulses that directly control automatic switches it would be necessary to pause after each button had been pressed to allow time for the switch to operate and obtain connection to the next switch so that the advantage of speed of operation would be lost. To meet this objection a register can

OVER



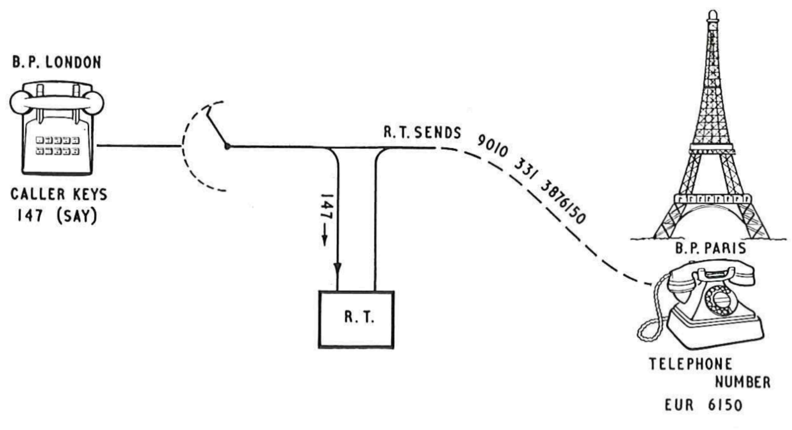
Above (top): Keying a number on a push-button telephone (seen alongside a dial telephone). The white rectangles above and below the keyset will contain the telephone number and brief instructions normally shown on the dial centre label. Below: a technician adjusts a push-button telephone from which the outer case is removed. Left: Diagram of a push-button telephone showing the arrangement of keys.

REGISTER-CONTROLLED PABXs *(Contd.)* be designed to respond immediately to the push-button signals, and store them and relay them, in the form of dial-type pulses, properly spaced, to the automatic switches. This will give the user the advantage of rapid "keying" but it will not speed up the time to connect him because this is dependent on switch operation which cannot be accelerated. As a result the caller will experience a pause of a few seconds after keying before he hears the ringing tone, particularly on calls to the public exchange network when as many as seven digits have to be sent for a local call and as many as ten for an STD call. In spite of this disadvantage nearly all who have used the few experimental push-button telephones on the Post Office Headquarters PABX say they prefer them to ordinary dial telephones.

The obvious way to avoid the pause after keying the required number would be to replace the existing step-by-step system switches by a new, rapidly-operating system similar to that obtainable with electronic switching (which also is register-controlled), but a PABX electronic switching system has not yet been developed to the production stage. Moreover, even when an electronic PABX becomes available it will be some time before most public exchanges are electronically operated; and, if connected to an ordinary automatic exchange, the subscriber would receive no benefit from the rapid operation of his PABX on calls by way of that exchange. The advantage would be felt only on internal calls. The present problem is how to get a better service out of the existing PABX equipment, much of which is quite new and will have a useful life of 20-30 years.

One way of obtaining advantage from the use of push-buttons in conjunction with ordinary automatic switching (register-controlled) is to employ a loud-speaking telephone or a "speaker-set" so that after keying a number the caller does not have to hold a handset to the ear to listen for a reply. He can then have both hands free to continue writing, turning over papers and so on until a reply is heard so that the pause is not so noticeable. (A speaker-set is a small loudspeaker that can be switched on to listen for a reply; it must be switched off again before the handset can be used for bothway speech.)

A different kind of advantage can be achieved by exploiting the translator element in the register-translator to obtain an ordinary telephone number of seven digits or so from a short code of only two or three digits. A register-controlled PABX could have its own repertoire or library of, say, the 100 telephone numbers most frequently called by extensions and each number could be identified by a two-figure code. The first figure would select one of ten groups of codes and the second one of the ten codes in that group. Access to the library could be made by keying a figure that is not otherwise used as the first figure of any number on the PABX. In this way, an extension user on Smith and Company's PABX wanting to call Brown and Company whose telephone number is TIPstaff 1234, instead of keying 9-8471234, might key 125 (1 to



This illustration shows how the British Petroleum Company's new London office may use the short-code repertory facility to call their Paris office by way of ISD.

★ *An article by Mr. W. J. E. Tobin in the Summer, 1960, issue of the Journal*—Keysending from Subscribers' Telephones—*described the advantages of the keysender, or push-button type of telephone. Loudspeaking telephones were described by Mr. H. Thwaite in the Spring, 1964, issue.*

get the repertory facility and 25 because that is the code allotted to Brown and Company and shown in the PABX directory.)

One of the advantages of this short-code facility is that it almost eliminates the risk of calls going astray because of dialling errors. So long as the caller keys 125 correctly the translator will always send out the full number 9-8471234 and the likelihood of getting a wrong number will be reduced. Another advantage is that the code is easy to remember and easy to key. This system will give rise to the possibility of competition between such short-code facilities and the existing use of private lines. If there is a very great deal of telephone traffic between Smith and Brown and if they are not too far apart it pays them at present to rent private lines over which a call can be made by dialling one or two figures, for example, 87. Private lines might still be the best means even after the short-code facility and push-button telephones became available but, if the traffic were not quite heavy enough or the distance between the two buildings made the cost of private lines prohibitive, the short-code facility would be an easy and attractive way of setting up calls.

A repertoire of 100 "popular" telephone numbers is the largest that can be searched by a two-digit code. Some organisations, however, might want a bigger library than this, which would require a three-digit code and give a capacity of 1,000 numbers. However, the benefit to be gained by increasing the capacity would be offset by increased cost of the equipment, the reduced convenience of codes that are not really short and the length of the list they would occupy in the PABX directory.

The short-code facility can be used for quite long distance calls by STD or International Subscriber Dialling (ISD) since the translator can be designed to send out any number of digits for any particular code no matter how brief. It is where very long trains of figures are involved, for example, 9 010 331 3876150 for a Paris number —that there is the greatest risk of wrong numbers or other troubles being caused in dialling, partly because of the complexity of the number and partly because of the slow action of the dial, which often allows the caller's mind to wander so that he loses his place half-way through the operation. Service observations show that some callers break off half-way through and start again and that others dial non-existent numbers some of which may be the result of errors of memory or losing the place. The translator, on the other hand, will send out any number of digits with mechanical infallibility. This is an advantage from the Post Office's point of view because switching equipment and line plant will not so often be occupied on ineffective calls which bring in no revenue.

However, the delay while the switches work will become even more noticeable on an STD call obtained by operating only three keys. Nevertheless, two large business organisations are now having PABXs specially designed for them by one of the manufacturers approved by the Post Office, so that they can obtain the benefits of push-button calling and the short-code facility. Both the new PABXs will also have the valuable direct dialling-in (DDI) facility which enables any distant caller to dial direct to an extension number, thus by-passing the PABX operator.

Registers and register-translators have been used for many years in director automatic exchanges where they are known as directors, and are used on all STD calls. Their application to PABXs is new.

A new telephone with push-buttons instead of a dial will be used in association with the new PABX at the British Petroleum Company's offices.

The short-code repertory facility, originally known as short-code dialling (SCD), was first intended to be used with ordinary dial telephones. The development of a not-too-expensive push-button signalling system made it practicable to obtain the advantages of push-buttons as well as of a short-code system. Any organisation wanting either one of these facilities is likely to be attracted to the other.

★ *The author wishes to acknowledge the contribution of the Automatic Telephone & Electric Co Ltd in the application of register control in the PABX design proposed for the British Petroleum Company's installation.*

THE AUTHOR

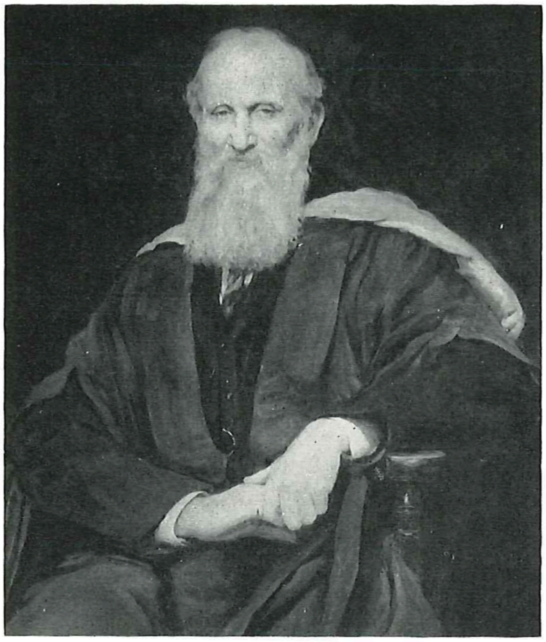
Mr. H. F. Edwards has been engaged in telecommunications work since entering the Engineering Department in 1924. He joined the Traffic grades in 1928 and since promotion to his present rank of Chief Telecommunications Superintendent, has worked in the London Telecommunications Region, where he was concerned with the London Directory Enquiry reorganisation; for the past nine years in the Inland Telecommunications Department where he has been occupied in helping to reorganise the inland telegraph service and, more recently, in the problems of Private Branch Exchange telephone service.

THE memory of Lord Kelvin, the man who more than anyone else was responsible for the introduction of submarine cables, was honoured on 26 June—the 140th anniversary of his birth—at ceremonies held in London and Detroit.

Speaking in London, Sir Albert Mumford, KBE, Engineer-in-Chief of the Post Office, appropriately reminded his audience that his tribute to a great man was being carried to the United States by means of submarine telephone cable.

To Lord Kelvin, son of a professor of mathematics at Glasgow University, the world owed many of the most significant advances in electrical engineering and in refrigeration. Entering Glasgow University at the age of 11, he was awarded the University Medal for his essay on "The Figure of the Earth" and contributed to the Cambridge Mathematical Journal before he reached 16.

Lord Kelvin, a man of genius, had 56 patents credited to him by 1900. He developed the basis for the absolute scale of temperature which now bears his name and proposed the sudden expansion of compressed air as a possible method of producing cooling effects, for use particularly for refrigeration.



Lord Kelvin, inventor, scholar, musician and oarsman whose ideas gave birth to submarine cables.

A Man of Genius

He then turned his attention to the making and laying of submarine telegraph cables and in 1857 joined the Board of the newly-formed Atlantic Telegraph Company whose object was to link Ireland and Newfoundland by a submarine telegraph cable. When the cable was laid in 1858, Kelvin sailed aboard the Agamemnon as an unpaid electrician. The cable failed after some ten weeks, but this was no reflection on Kelvin. It was entirely due to him that the more successful cables of 1865 and 1866 were laid. The mirror galvanometer and the syphon recorder which he patented in 1867 were devised to respond more readily to the very feeble signalling current.

Later, Lord Kelvin made many improvements to the mariner's compass and invented a new method of taking soundings in shallow and deep water, a tide gauge, a tide predictor and a tidal harmonic analyser. Even in his last years he was still interested in all aspects of current scientific research and wrote on various aspects of atomic theory and on the new electron theory.

Lord Kelvin, who died in 1907 and was buried in Westminster Abbey, was nothing if not versatile. He rowed for his college at Cambridge; helped to found the Cambridge University Musical Society, himself playing the french horn in the orchestra; and was very well versed in the classics, often quoting from Latin and Greek authors.

It was appropriate that Sir Albert Mumford, who is President of the Institution of Electrical Engineers, should have paid this tribute to a brilliant man. Lord Kelvin was President of the Institution in 1874, 1889 and 1907.

In this article on the Portsmouth Telephone Area, Mr. F. T. GIBBS, a retired Executive Engineer, tells of the unusual problems and achievements of a telephone service that began in a room above a grocer's shop

PORTSMOUTH:
FROM SEMAPHORE TO STD

Seventy-eight years ago in a room above Alderman Pink's grocery shop in Surrey Street, Portsmouth's first telephone exchange—for 50 subscribers—was opened.
Courtesy: Studio Blake.

THE Portsmouth Telephone Area, spread over nearly 600 square miles of Hampshire and Sussex and including the Isle of Wight, has very close links with the early days of communications.

In the late 1700s a chain of semaphore signalling stations was set up on hilltops between Southsea Common and the Admiralty and on clear days messages could be exchanged between Portsmouth and London in ten minutes. In the early 1860s, four-core, gutta-percha submarine cables were laid from Portsmouth Harbour to the Isle of Wight to transmit electric telegraphs.

OVER

The supervising staff when the Strowger exchange was opened in Portsmouth's Head Post Office in 1916. They are (left to right): Messrs W. J. Knox, D. Hishon, L. W. Chambers, W. Harknett, T. E. Devonshire, G. Ogburn, H. Yeatman, R. Lockwood and S. Gibbs. Relatives of some work in the Post Office today.

SEMAPHORE TO STD *(Contd.)*

A few years later—in 1878—Dr. Alexander Graham Bell, the inventor of the telephone, demonstrated telephony to Queen Victoria at Osborne House near Cowes, in the Isle of Wight. After the Queen had spoken over Bell's apparatus to Sir Thomas Biddulph at Osborne Cottage, two miles away, a circuit was set up between Osborne House and Cowes, Southampton and London and the Queen listened to a bugle sounding the Retreat in Southampton and a recital of organ music in London. She was so impressed that a few days later she commanded Sir Thomas Biddulph to purchase "from that clever Mr. Bell, a pair of telephones and the wires to connect them." This was probably the first private wire.

The first telephone exchange in Portsmouth was opened in 1886 in premises over Alderman W. Pink's grocery shop in Surrey Street at its junction with Commercial Road. Initially catering for 50 members (as subscribers were then called), it was operated by the Western Counties and South Wales Telephone Company until 1889 when the National Telephone Company took it over. It remained over the grocer's shop until 1916 but by that time it was only one of three telephone exchanges in the city.

In 1902, following allegations that the National Telephone Company was too dictatorial in the matter of tariffs and paid scant attention to complaints about service or charges, the local council opened a Municipal Telephone Exchange in the Town Hall (now the Guildhall) which had some 500 subscribers on ten manual positions. In addition, there was the Trunk Service operated by the Post Office from a suite of enormously tall and heavy positions in the Head Post Office in Commercial Road. This threefold system did not work very well, however, and about 500 busy subscribers were compelled to rent telephones from both the National and Municipal organisations to cater for their needs.

The two opposing local systems flourished reasonably, although the National Telephone Company had to apply to the Portsmouth Council for "wayleaves" (right of way rented or negotiated) for underground cables and poles. Since the local authority had joined the telephone business it could hardly be expected to bend over backwards to grant such facilities to a competitor.

So the National Telephone Company evolved an aerial cable distribution scheme by way of a huge steel derrick erected on the roof of the grocer's shop from which large aerial cables supported on 60 ft. high poles radiated in all directions.

As the system grew and more equipment was installed in the National Telephone Company's Exchange, lack of space forced the Company to extend the main frame in the form of a rectangle instead of in the normal straight line. By the time the exchange ceased to function over the grocer's shop the main frame had become a complete rectangle except for a two-feet square aperture at ground level through which the unfortunate maintenance staff had to crawl to attend to the "jumpers" (lengths of flexible wire connecting the subscriber's apparatus line from outside the exchange to the correct number inside) or to make

changes of numbers.

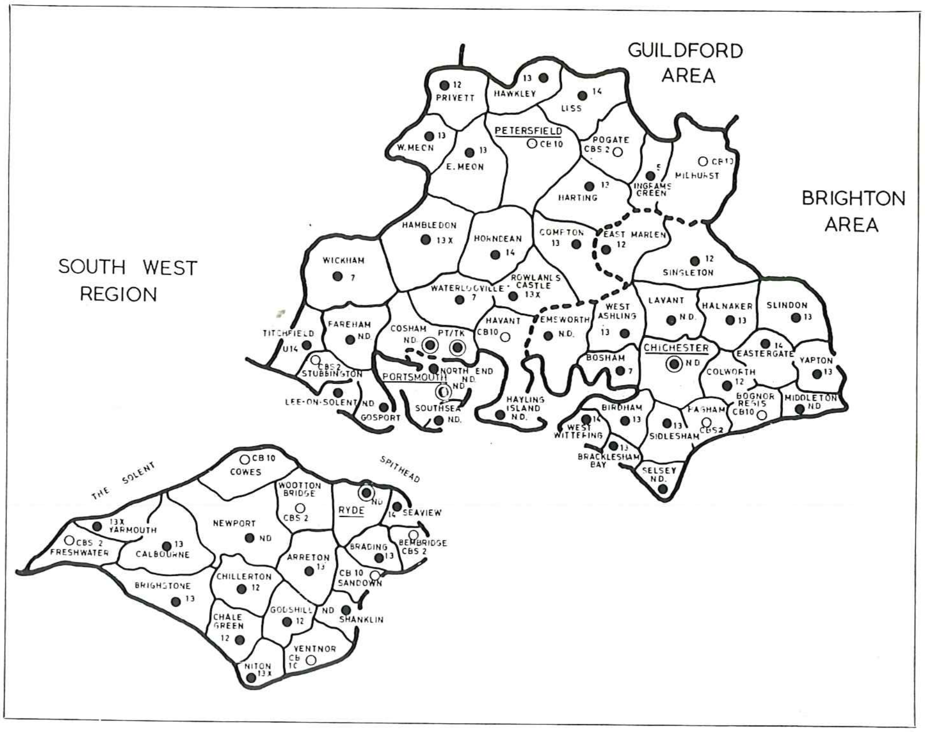
The Municipal Exchange expanded steadily and had no difficulty in obtaining wayleaves for underground cables or poles since the Telephone Service was a Corporation Department. By the time the Municipal system had closed down after being absorbed by the Post Office in 1914, the switchboard in the Town Hall had increased to 2,000 multiple and other exchanges had been opened at Eastney and North End. Impartial observers thought the Municipal system gave the slightly better service. The only major matter on which both the National and Municipal factions agreed was that the Post Office ran the trunk system inefficiently and made exhorbitant charges!

On 1 January, 1912 (after signing an inventory which included all the spare arm bolts held in engineering stores throughout the country) the entire system operated by the National Telephone Company was taken over by the Post Office which then made the momentous decision that Portsmouth should have an automatic exchange (the first public automatic exchange had been opened at Epsom only two years before). The outbreak of World War One threatened to put a stop to the project but the Post Office pressed on and on 22 April, 1916, the new automatic exchange, with 3,500 subscribers, 5,000 multiple, was opened for service. In the meantime, the Portsmouth Corporation had abandoned the Municipal Telephone Service which, in turn, was also taken over by the Post Office.

When the new automatic exchange was opened the staff was composed mainly of youths who were trained in the operation and maintenance of the equipment by American members (then exempt from war service) of the Automatic Telephone Manufacturing Company of Liverpool which installed the exchange.

The switches in the new exchange were basically the same as any two-motion switch since developed, but they were roughly put together, had little or no protection from dust and were not designed for accurate adjustment. So long as a switch rattled up smartly, cut in cleanly, stopped on the right contact and dropped out when the caller hung up everybody was happy. There were three degrees of spring tension: strong, medium and weak. In addition to the two-motion switches the equipment

OVER



The Portsmouth Telephone Area. It covers about 600 square miles and was made up from portions of the old Southampton, Guildford and Brighton sections when regionalisation was introduced in 1937-38. The Area is mainly residential and agricultural.

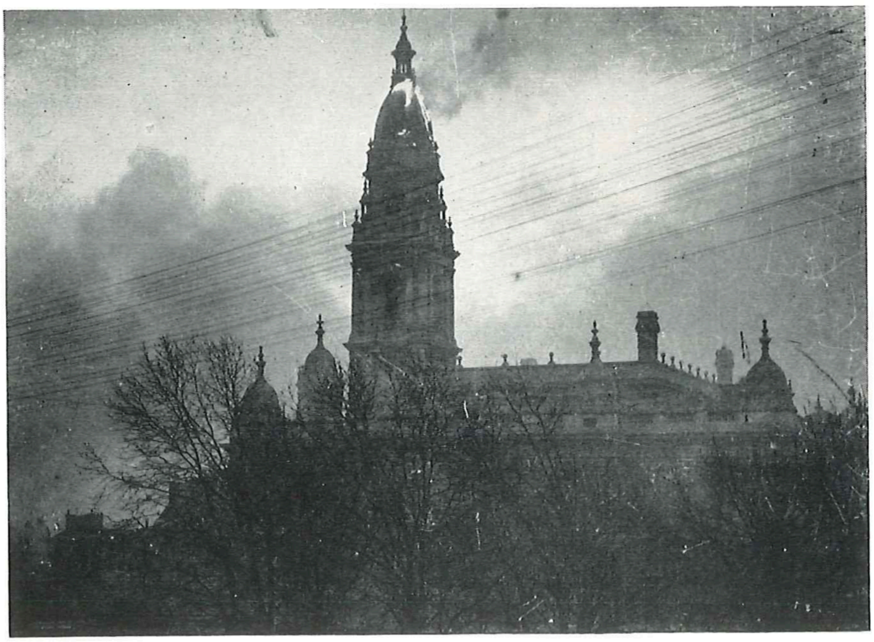
SEMAPHORE TO STD *(Contd.)*

included Keith Line switches—fragile looking metal darts plunging under the encouragement of an electro-magnet into a bed of tiny, flat brass contact springs. They operated when a subscriber lifted his receiver and put him through to a two-motion selector switch, ready to dial the first digit. Although even the experts predicted that these contraptions would fall to pieces in a few years, most of them functioned well during the whole of the equipment's lifetime of 42 years.

Late in 1918, after the new exchange had become well established, a major scheme for the automatisation of the exchanges adjacent to Portsmouth was put in hand. Cosham, Gosport and Hayling Island were converted to auto switching in 1926 to take the place of manual exchanges at these places and also at Alverstoke, Brockhurst and Portchester. The Lee-on-Solent area was converted in 1932 and two years later a large manual board was installed in the Head Post Office in Portsmouth to cater for trunk demand working. These developments entailed extensive and complicated underground cabling works, all of which were carried out without the loss of a single pair.

From 1938 until the outbreak of World War Two preparatory work on communications for the three Armed Services was unobtrusively pushed forward. The pace quickened in 1939 and a vast and varied programme of work was undertaken not only in the Portsmouth City area but also in most of the nearby towns and villages. Communication apparatus, ducts, cables and lines were provided in unprecedented quantities for anti-aircraft defence and balloon barrage sites, mobile smoke screen units, airfields, civil defence organisations and operational headquarters for all three fighting services. The Post Office also set up the massive network of communications for the combined Allied Headquarters located in the Cosham exchange area north of Portsmouth harbour, and from which the initial operations for the invasion of Europe were directed. It also provided dozens of teleprinters, hundreds of telephones and a huge lines network for the many thousands of troops who converged on the Portsmouth area.

During the War Portsmouth area suffered many heavy air attacks. Many poles and open wires were destroyed and damaged but cables, on the whole, escaped almost miraculously. Two big bombs fell into Commercial Road outside the Head Post Office, which housed the Portsmouth manual board and telephone exchange, only ten feet away from the main underground track leading into the



Portsmouth Guildhall, its tower ablaze, during a World War Two air raid. In this building (then the Town Hall) the local authorities opened a municipal telephone exchange for 500 subscribers in 1902.

Courtesy: Evening News and Hampshire Telegraph.

A City Steeped in History

Portsmouth, for centuries the premier naval port in Britain, is rich in historical associations.

In 1415 Henry the Fifth embarked from there with 30,000 men to land in Normandy. More than 400 years later—on 6 June, 1944—a similar expedition with much the same objectives was controlled from Portsmouth.

Admiral Byng was tried by court-martial at Portsmouth on a charge of "declining to engaged the enemy" and was later shot on board the Monarque lying in the harbour. Admiral Nelson left from Portsmouth in 1805 to rout the French at Trafalgar. His flagship, HMS Victory, is today preserved in Portsmouth Dockyard.

Charles Dickens was born in Portsmouth in 1812 and his birthplace, a terrace house near the dockyard in Commercial Road, is now a museum. Sir Arthur Conan Doyle, creator of Sherlock Holmes, was a general practitioner at Southsea not far from Telephone House.

Right: In this house Charles Dickens was born.

building. The ducts were damaged but the cables were unharmed. Two exchanges in the Portsmouth area—Stubbington (manual) and Hayling Island (auto)—were severely damaged but in both instances the apparatus was only slightly damaged and was put into working order a few hours later.

During the extremely heavy raids on Portsmouth the telephonists showed commendable courage, calmly carrying on with their duties until ordered to take refuge. On at least two occasions both the Head Post Office and Telephone House were saved from burning by the staff's prompt actions.

When World War Two was over the replacement of the old Strowger automatic exchange in the Head Post Office became urgent. By dint of careful maintenance the old installation had survived for 39 years but even the apparently indestructible Keith Line switches would not go on plunging for ever. By this time, too, most other auto switching exchanges in the country had enclosed switches of a vastly improved design and performance, with relays and switch gear capable of precise adjustment.

A major scheme to provide a modern auto exchange for Portsmouth Central, a similar exchange for the Portsmouth North End area with a manual trunk exchange at Portsmouth Central, to serve Portsea Island, and another at Cosham, to serve the remaining exchanges, was agreed. Spacious and well-designed new buildings to house the new exchanges were erected in Park Road, near the Guildhall; in Derby Road, North End, and in Northern Road, Cosham, for the trunk exchange. All three were opened in July, 1958.

The unit automatic exchange at Fareham, originally intended for a maximum of 800 lines but subsequently extended to 1,600, was replaced in October, 1958, by a modern exchange in a new building and in 1959 Gosport Exchange was

OVER

Above: The Central Exchange, in Park Road, Portsmouth and (right) a rooftop view of the Portsmouth Trunk Exchange at Cosham.
Courtesy: Studio Blake.

SEMAPHORE TO STD (*Concluded*)

replaced by a new one on a new site.

Subscriber Trunk Dialling was introduced into the Portsmouth area in April, 1962, when some 2,500 Ryde (Isle of Wight) subscribers were enabled to dial their own numbers over a large part of the country. In the following January the five large exchanges comprising the Portsmouth linked area were given STD facilities over an extended dialling range, thus adding some 20,000 to those already enjoying STD. The manual board at Park Road, Portsmouth, was closed in 1963 and the remaining traffic was concentrated on the Trunk Exchange at Cosham. The rise in the amount of trunk traffic has been so great that the equipment and building have had to be considerably extended. The space left spare in the Park Road building has provided much needed accommodation for a mechanised accounting and ticket sorting unit which operates under Regional direction for several areas.

STD was extended to include Newport, Isle of Wight, in 1963 and Shanklin in February this year. Work is in hand to convert the remaining five manual exchanges in the Isle of Wight to automatic working and to replace the six on the mainland in the next few years. Chichester and Petersfield areas will be given STD by the turn of the 1960s when, no doubt, the Portsmouth area will be tackling fresh problems to ensure that the latest and the best in telecommunications is available to the subscriber.

THE AUTHOR

Mr. F. J. GIBBS, who retired in 1961, joined the Post Office in 1912 as a casually-employed firepot boy in a heavy overhead construction gang at Southampton. The following year he became a Youth-in-Training at Portsmouth and from 1921–24 was a Skilled Workman Class II at the Portsmouth Automatic Exchange. In 1924 he was appointed a Skilled Workman Class I and from 1925–37 was an Inspector, employed successively at Marlborough Repeater Station, in the Ryde Technical Section, at Reading and in the Engineer-in-Chief's Office. In 1937, Mr. Gibbs was promoted Chief Inspector; in 1947, Assistant Engineer (old style) and in 1950, Executive Engineer.

During his service Mr. Gibbs wrote ten pantomimes and a musical play for the Portsmouth Area Social Club.

PERSONALITY GIRL, 1964

THE *Journal* congratulates Mrs. Hilda Ferguson, an overseas telegraphist at Electra House, London, who at a BBC television show on 14 July, was proclaimed GPO-Interflora Personality Girl of 1964.

Runner-up was Miss Carol Martin, a telephonist at the Continental Exchange in London, and third Miss Rosaleen McCormack, a telephonist from Omagh, Northern Ireland.

All three finalists won a fortnight's holiday at Alassio, Italy, and in addition Mrs Ferguson was presented by the Postmaster General with a cheque for £100. Miss Martin also received a cheque for £75 and Miss McCormack one for £50. In addition, the Postmaster General presented to the winner a cut glass vase given by the Union of Post Office Workers to be displayed at Electra House.

Loudspeaking Telephones

In the article Loudspeaking Telephones in our Spring, 1964, issue a caption referred to the American Shipton LST. We are asked to point out that there is nothing American, either directly or remotely, in connection with Shipton Automation (Manufacturing) Ltd which makes the LST. The photograph was of an early prototype of the EDAS Master—a loudspeaking telephone suitable for use on any Strowger system.

The Bell Company's Speakerphone, which was illustrated on page 29 is a voice-switched instrument although the original telephone was non-switched.

Telecommunications Statistics

In this issue the figures presented are for the complete financial year to 31st March, 1964, compared with those for the two previous years.

	March 31st 1962	*March 31st* 1963	**March 31st 1964**
The Telephone Service at the end of the Year			
Total telephones in service	8,624,000	8,927,000	**9,366,000**
Exclusive exchange connections	4,084,000	4,254,000	**4,506,000**
Shared service connections	1,126,000	1,100,000	**1,114,000**
Total exchange connections	5,210,000	5,354,000	**5,620,000**
Call offices	74,250	74,540	**74,780**
Local automatic exchanges	5,277	5,387	**5,486**
Local manual exchanges	733	624	**533**
Orders on hand for exchange connections ...	147,000	161,000	**172,000**
Work completed during the year			
Net increase in telephones	344,000	312,000	**439,000**
Net exchange connections provided	459,000	434,000	**555,000**
Net increase in exchange connections	173,000	145,000	**267,000**
Traffic			
Effective inland telephone trunk calls	477,000,000	545,000,000	**624,000,000**
Cheap rate inland telephone trunk calls	112,000,000	125,000,000	**139,000,000**
Overseas telephone calls:			
Outward	3,736,000	*†4,391,000	**5,094,000**
Inward	3,788,000	*†4,382,000	***4,652,000**
Transit	95,000	*99,000	***120,000**
Inland telegrams (including Press, Service, Railway and Irish Republic)	14,590,000	13,947,000	**11,684,000**
Greetings telegrams	3,056,000	3,135,000	**2,618,000**
Overseas telegrams:			
Originating UK messages	6,477,000	6,318,000	**6,468,000**
Terminating UK messages	6,454,000	6,381,000	**6,545,000**
Transit messages	5,401,000	5,216,000	**5,133,000**
Inland telex:			
Metered units (including Service)	77,018,000	99,184,000	**125,211,000**
Manual calls (including Service and Irish Republic)	102,000	126,000	**154,000**
Overseas telex calls	4,304,000	5,545,000	**7,173,000**

†*Amended figures.*
**Includes some estimated figures.*

A NEW EUROVISION LINK

MICROWAVE radio systems, costing about £175,000, are to be installed between the Post Office Tower in London and Lille, northern France, to provide a permanent 625-line Eurovision link and up to 1,800 two-way telephone circuits.

The new transistorised microwave equipment will replace the BBC's temporary Eurovision link between Folkestone and London and installation is expected to be complete by late 1965 or early 1966. The first stage will be between the Post Office Tower and a 200 ft-high tower on Tolsford Hill, near Folkestone. Telephone circuits will be carried from Tolsford Hill to Lille by an existing microwave link completed in 1959 and by a further new microwave link of 600 circuit capacity. Television signals will be carried to Lille by the existing link, also completed in 1959.

The new equipment, which will be supplied by Standard Telephones and Cables, will operate in the 6,000 megacycles band on the London to Tolsford links and provide two both-way television channels or telephone channels of 1,800 circuit capacity. There will also be two unidirectional television channels in the London to Tolsford Hill direction. The link between Tolsford Hill and Lille will operate in the 4,000 megacycles band and provide 600 telephone circuits.

Extras 937,000

Although bad weather curtailed so much playing time in the second England v. Australia Test Match at Lords, many more calls were made to the Test Match Score Service this year than during the same test in 1961—1,450,000 against 1,098,000. Total calls during the third Test Match were 1,439,000 compared with 854,000 in 1961.

NORTH SEA CABLES

On page 23 of Summer, 1964, issue it was stated that a £2 million contract for three new cables—Britain to Norway, Britain to the Netherlands and Norway to Denmark—had been awarded to Standard Telephones and Cables Ltd. In fact, the contract was awarded to Submarine Cables Ltd. to whom the *Journal* apologises for its error.

Each of the new cables will include transistorised repeaters with a capacity of 480 circuits—the first time that contracts have been placed anywhere for systems of such large capacity. Two of these 480-circuit cables are among the six referred to earlier in the same article as having the same capacity—120 circuits—as the first Anglo-German cable.

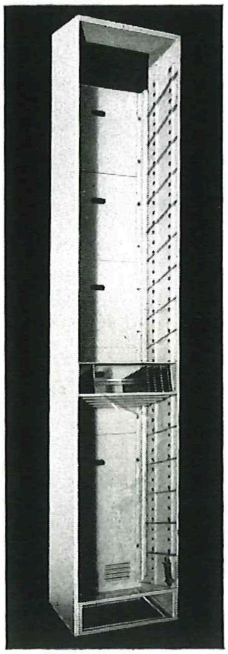
Publication and Price. The *Journal* is published in February, May, August and November, price 1/6. The annual postal subscription rate is 6/6 to any address at home or overseas.

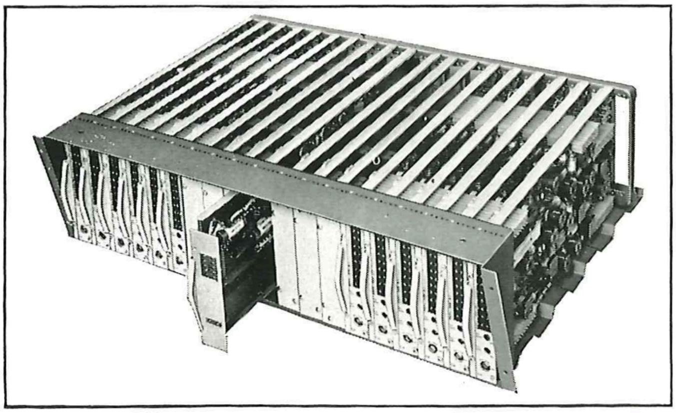
Contributions. The Editorial Board will be glad to consider articles of general interest within the telecommunications field. No guarantee of publication can be given. The ideal length of such articles would be 750, 1,500 or 2,000 words. The views of contributors are not necessarily those of the Board or of the Post Office.

Communications. Communications should be addressed to the Editor, Post Office Telecommunications Journal, Public Relations Department, GPO Headquarters, St. Martin's-le-Grand, LONDON, E.C.1. Telephone: HEAdquarters 4345. Remittances should be made payable to "The Postmaster General" and should be crossed "& Co."

GPO

62 TYPE





Shelf unit construction
Flexibility in equipment layout

The shelf unit construction of the 62-type transmission multiplex equipment combines the compactness of modern equipment design with ease of installation and maintenance. The 450 mm deep racks are compatible with double-sided racks in existing installations which have the C.C.I.T.T. recommended depth. The design, which has been accepted as standard by the British G.P.O., gives maximum concentration of transistorized units in the rack space, yet with easy access from the rear to all wiring connexions. Soldered connexions in the station wiring are reduced to the minimum possible. Miniaturized components are mounted on well-screened plug-in printed circuit boards which by a simple extension device can be inspected and tested in their working positions. Reduction in equipment heat dissipation and improved ventilation avoids high equipment temperatures and gives more reliable performance. 62-type shelf units are supplied as factory wired and tested units which allow a high degree of flexibility in equipment layout and extensions. For further information write, 'phone or Telex: Standard Telephones and Cables Limited, Transmission Systems Group, Marketing Department, North Woolwich, London, E.16. Telephone ALBert Dock 1401. Telex 21645.

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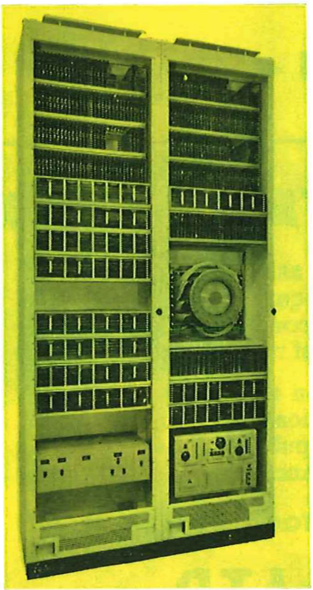

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